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ABSTRACT

This instructor's guide accompanies the self-paced student training modules on auto mechanics, one of which is available separately as CE 032 867. Introductory materials include an introduction to pre-apprenticeship and its three phases of training, a recommended preocedure for conducting pre-apprenticeship training, and a course outline. Teaching outlines are then provided for the 10 modules that comprise this course. For each module some or all of this material may be presented: instructional outcomes; introduction; outline of content with teaching methods and aids listed and/or sketched, notes for self-assessment, assignment, and post assessment; and suggested readings. Modules include Introduction to Automobile Mechanics Trade, Diagnostic Testing/Automobile Service, Survival Skills, Trade Math (diagnostic test and remedial work), Physical Requirements, Safety, First Aid, Trade Tools, Automotive Systems/Components, and Applied Auto Mechanics (student projects). Project sheets are provided. An occupational analysis/task inventory for auto mechanic is appended. (YLB)

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INDIVIDUALIZED LEARNING SYSTEMS

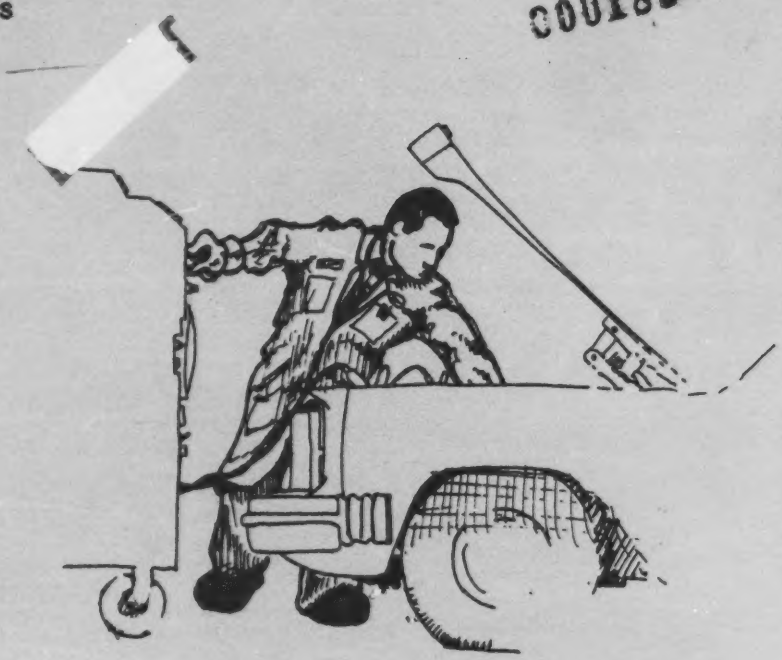
PRE-APPRENTICESHIP

PHASE 1 TRAINING
Instructor's Guide

Auto Mechanics

Diagnostic Tests
Survival Skills
Math
Tools
Materials
Project

C00183



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INTRODUCTION TO PRE-APPRENTICESHIP

DESCRIPTION OF APPRENTICESHIP

The Federal Bureau of Apprenticeship identifies an apprenticeable occupation as a skilled occupation that requires a minimum of one year of 2000 hours on-the-job training. This on-the-job training and related educational training is the apprenticeable period.

VIEWPOINTS ABOUT PRE-APPRENTICESHIP

Pre-apprenticeship is viewed in many different ways by craftpersons, apprenticeship committees, educators and the general public.

Concerns about pre-apprenticeship include the belief that the pre-apprenticeship training will flood the market with applicants for apprenticeship or that these trainees will go to work in the occupation as partly trained workers or that pre-apprenticeship would be considered a guarantee of entry into apprenticeship. These conflicting viewpoints create problems for persons interested in apprenticeship training and make it difficult to operate pre-apprenticeship training programs.

NEED FOR PRE-APPRENTICESHIP

Pre-apprenticeship provides three benefits:

1. Provides a screening device to determine motivation, interest, manipulative aptitude and ability of persons to learn the skills of the occupation.
2. Provides the individual with survival skills for handling personal problems and interpersonal relations on the job that may include abuse and sexual harrassment.
3. Provides entry level skills to help make the apprentice productive from the first day on the job. The higher entry level skills of the apprentice provides an incentive for the employer to hire apprentices.

PRE-APPRENTICESHIP HELPS PEOPLE

To select a skilled occupation.
To identify the educational requirements of an occupation.
To experience the hands-on skills of an occupation.
To develop good work habits.

* Good job attendance
* Punctuality
* Dependability
* Time management

To develop good attitudes.

* Concern for the job
* Initiative
* Interest
* Healthy, cooperative working relations with fellow employees.

TRAINING LEVELS FOR PRE-APPRENTICESHIP

Pre-apprenticeship training can be separated into three phases or stages of training. These are:

PHASE 1

Provides the trainee with an opportunity to explore several occupations. This orientation to the carpentry trade includes training in trade terminology, blueprint reading, tool usage, first aid and safety practices. This familiarization training includes hands-on experience in some of the basic skill areas together with information about the advantages and requirements of carpentry. The choice of an occupation to train for in Phase 2 of pre-apprenticeship will be based on these experiences. If the trainee decides not to pursue this occupation any further, the training received to this point will be useful in every day life.

Phase 1 includes diagnostic tests to determine if reading or mathematical deficiencies exist that would handicap a person in the carpentry trade. Remedial work will be provided to correct these deficiencies.

Success on the job is directly related to job attitudes, work habits, and the individual survival and coping skills. Training will begin on helping each individual attain full potential in these personal skills.

Interpersonal skills will be developed which include:

* Communication skills
  - paraphrasing, perception checks, non-verbal communication
  - communicating with superiors
* Personal effectiveness
  - problem solving, family relationships, sexual harrassment and pestering on the job.
* Interview techniques
  - apprenticeship committee interview procedure

PHASE 2

This training begins the serious preparation for an occupation. The training related to job attitudes, work habits and individual survival and coping skills will be continued from Phase 1 with more emphasis on the relationship to the job.

Manipulative skills will be developed by the completion of a series of projects involving basic trade skills which have a carryover benefit to persons outside of the occupation. At least 3/4 of the training will consist of hands-on experiences. This instruction should be conducted by a skilled craftsperson from the trade or occupation who has the necessary teaching skills.

The joint apprenticeship committee for the occupation will be invited to observe the progress of trainees during Phase 2 and to evaluate the potential for trainees for entry into apprenticeship. The participation of the appropriate joint apprenticeship committee is essential to the success of a pre-apprenticeship program. This community involvement insures that the training is relevant to the occupation and meets industry training standards.

At the completion of Phase 2 the trainee will have enough experience with the occupation to decide whether to continue with the training into Phase 3. The joint apprenticeship committee will have knowledge of the quality of the training program and will be in a position to judge the qualifications of the students for entry into the apprenticeship training program.

PHASE 3

Training is concentrated on improvement of manipulative skills so that the trainee will be a productive employee the first day on the job. This training can be either industry conducted specialized training, secondary school vocational programs or community college preparatory courses specifically related to the occupation. Trainees can also participate in co-op work experience involving hands-on training at the secondary or community college level. Hands-on training is considered essential for an effective pretraining program.

The Phase 3 training period provides the trainee with an opportunity to search for an employer willing to take an apprentice. Frequently the employer providing co-op work experience training will hire the trainee as a regular employee.

It is possible that some employers will hire the trainee without further training. Some of these employers train specifically for their own needs. In the process, job descriptions have become highly diluted. Instead of producing journeymen possessing a wide range of skills, companies have settled for specialists trained to perform the specific tasks needed in certain narrow operations. While this may be adequate to meet the special needs of an industry, it certainly will not meet the training and manpower needs of the nation in the future.

Apprenticeship provides a broad base of training by giving the apprentice a wide range of skills which insures continuous employment. Workers least vulnerable to unemployment are those with the highest and broadest skills and best training. The trainee should make every effort to enter an apprenticeship training program designed to provide training in all skills required

in the trade or go to work for an employer who will provide broad based training.

Each trainee will choose a joint apprenticeship committee meeting to attend during Phase 3 training. This will provide an opportunity for the trainee to become acquainted with members of the joint apprenticeship committee and to see how the committee functions.

PHASE 4 EMPLOYMENT AS AN APPRENTICE

Trainee enters apprenticeship training on a direct referral basis under agreement with the appropriate joint apprentice committee which permits persons trained in programs financed with federal funds to enter apprenticeship on direct referral. Direct referral eliminates several of the procedures in the selection process and makes entry into apprenticeship less cumbersome.

Not all joint apprenticeship committees use the direct referral system. This is the reason why sponsors of pre-apprenticeship training should directly involve joint apprenticeship committees in the operation of their programs. This provides committees with an opportunity to evaluate the effectiveness of pre-apprenticeship.

The federal Job Corps Programs enjoy direct referral placement in apprenticeship for their graduates. The Job Corps operates an ideal pre-apprenticeship program. Proposed sponsors of pre-apprenticeship training are advised to visit the nearest Job Corps Center to see how the programs operate.

The Job Corps Centers in Oregon are located at:

Angel Job Corps
Star Route North
Yachats, OR 97498
547-3137

Timber Lake Job Corps
Star Route Box 109
Estacada, OR 97023
834-2291

Wolf Creek Conservation Center
Little River Route
Glide, OR 97443
496-3507

Tongue Point Job Corps
Astoria, OR 97103
325-2131

Job Corps Centers in Oregon Offer Training in these apprenticeable occupations:

Carpentry	Plastering	Automotive
Cement Mason		Painting
Brick Laying	Tile Setting	

RECOMMENDED PROCEDURE FOR CONDUCTING PRE-APPRENTICESHIP TRAINING

ADMINISTRATION

Pre-apprenticeship training can be conducted by various sponsors. These include. secondary schools, community colleges, unions, employer associations, labor/management training trusts and private groups such as O.I.Cs.

ADVISORY COMMITTEES

Use of broad-based community advisory committees is mandatory for pre-apprentice ship programs conducted by secondary schools and community colleges. Pre-apprenticeship needs the support and recognition of the community in order to be successful.

The advisory committee should have representatives from these groups:

School administration
- -high school principal
- -board members
- -vocational director
- -co-op work experience
- -T & I instructors

Community
- -school graduate in trade
- -member of joint apprenticeship committee
- -employer member of trade
- -employee member of trade
- -union business agent
- -industry training coordinator
- -representative of financial community
- -representative of press

Government personnel
- -ESD regional vocational coordinator
- -Oregon Division of Apprenticeship field representative
- -Federal Bureau of Apprenticeship representative
- -State Dept. of Education specialist

FINANCING

Vocational training programs generally cost more than academic programs because the student/teacher ratio is smaller, consumable supplies are required, and expensive equipment is needed. Resources to finance pre-apprenticeship training are available from a number of sources. These include:

Vocational rehabilitation	-tuition fees
Federal funds for immigrants	-Asian -Cuban -Spanish American
Special grants	-U.S. Dept. of Labor U.S. Dept. of Education CETA Industry State Dept. of Education Economic Development Administration
Secondary school funding	-basic school grant from federal funds
Community college funding	-basic state funding

INSTRUCTIONAL DELIVERY SYSTEMS

The type of sponsor for pre-apprenticeship training will determine the time-block used for the program. If training is started at the 9th grade level, a two-hour training period will generally be used. A half-day training period should be used for an accelerated program at the secondary level covering two years. Community college programs can be either half-day or full-day programs. Private sponsors generally will operate on a full-day basis.

Instructors for the trade specific training should be qualified craft workers. These may be employed on a part-time basis, or full-time, serving several programs. The necessity for skilled workers to teach the trade specific items of the program

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cannot be over-emphasized. The work experience of skilled craft workers gives them the insight into the occupation needed for effective teaching.

MANIPULATIVE SKILL TRAINING

The manipulative skills or hands-on experiences provide the basis for a sound and effective pre-apprenticeship training program. Unless this training is available the program will not succeed.

Important considerations involve the following items:

Basic tools	-tools required for each participant
General or shop tools	-power tools (purchased or rented)
Materials	-purchased by training agency -purchased by others (training project sponsor) -donations by industry (defective goods)
Training facilities	-school based -community based
Training projects	-school maintenance work -simulated projects -community projects -private projects (non-profit organizations-low income persons)

COORDINATION WITH EXISTING PROGRAMS

Pre-apprenticeship should be coordinated with related programs in secondary schools and community colleges.

Welding	Electronics
Blueprint reading/drafting	Industrial mechanics cluster
Surveying	Construction cluster
Automotive	Electricity/electronics cluster

MISCELLANEOUS CONSIDERATIONS

Legislation, community support and political considerations will all have an effect on pre-apprenticeship training. Activities related to these concerns include:

Workshops and technical assistance	-State Dept. of Education
Publicity notices	-public service -newspaper -radio -translation to Asian/Spanish American
Civil rights	-effect of civil rights compliance
Transfer of learning	-benefits of vocational training to other occupational endeavors

COURSE OUTLINE

1.0 Introduction to the Automobile Mechanics Trade

- 1.1 History
- 1.2 Trends
- 1.3 Working Conditions
- 1.4 Hiring Practices
- 1.5 Training
- 1.6 Employment Opportunities
- 1.7 Wages
- 1.8 Common Worker Benefits
- 1.9 Trade Terminology

2.0 Diagnostic Testing

- 2.1 SATB

3.0 Survival Skills

- 3.1 Expectations
- 3.2 Communication Skills
- 3.3 Giving and Receiving Feedback
- 3.4 Dealing with Interpersonal Conflict
- 3.5 Group Problem Solving, Goal Setting and Decision Making
- 3.6 Wider Influences and Responsibilities
- 3.7 Identifying and Developing Individual Strengths
- 3.8 Worksite Visits
- 3.9 Resumes
- 3.10 Interviews
- 3.11 Appropriate Work Habits and Attitudes

4.0 Trade Math

- 4.1 Math Diagnosis
- 4.2 Math Remedial

5.0 Physical Requirements

- 5.1 Physical Requirements
- 5.2 Developmental Processes

6.0 Safety

- 6.1 General Safety
- 6.2 Personal Safety
- 6.3 Fire Types and Prevention
- 6.4 Hygiene Safety
- 6.5 Hand Tool Safety
- 6.6 Power Tools

7.0 First Aid

7.1 First Aid

8.0 Trade Tools

8.1 General Tools
8.2 Measuring Tools
8.3 Other Tools and Equipment
8.4 Hand-held Power Tools

9.0 Automotive Systems/Components

9.1 Electrical Components
9.2 Ignition Systems
9.3 Fuel Systems
9.4 Cooling system
9.5 Oils and Greases
9.6 Automotive Fluids
9.7 Engine Lube System

10.0 Project

II. WORD TO THE INSTRUCTOR

This course was designed to be a trade-related, self-screening, job exploration package, providing the student with basic trade theory, basic trade manipulative practice, projects and on-job-site visitations.

Further, it is to be implemented by instructors who are skilled in each of the general topics described in the course outline and expanded on in the instructor's guide.

The curriculum is comprised of two parts: 1) the instructor's guide, and 2) supporting modules and references which are specified in the instructor's guide. The instructor should seek other supporting resources where available or necessary.

The instructor should bear in mind that there are two broad objectives written into the design of this course: 1) that the student will receive instruction in the preapprenticeship mode of the trade (which is designed to enable him or her to gain enough exposure to the trade to (a) aid in making a career decision, and (b) facilitate entry into the trade), and 2) that the student will retain some carryover skills which he or she can use in life, even should the student decide not to enter the trade.

Essentially, this guide is patterned after a program begun in Oregon in 1979-80. The participants in the program are wholly CETA-sponsored, many with motivational or physical impairments. The program concentrates on providing motivational support and/or physical therapy. A typical program, broken down into its major components, would be:

- 40% hands-on, manipulative work
- 30% motivational support work
- 10% job visitation
- 5% physical development or therapy
- 15% class lecture, discussion, etc.

Not all institutions will have the resources, nor will all programs' students have the need, for such a breakdown. The instructor should identify the needs of the students and utilize the guide in the manner best suited to meet them.

III. RECOMMENDATIONS

Hands-on work is probably the best learning experience for students in trade work. It is essential if the two broad objectives listed above are to be met. Therefore, implied in the topics covering tools, materials and tasks or work processes is the notion (emphasized in the Instructional Outcome for these topics) that the student will practice using the tools and materials described therein.

In lieu of describing in the Teaching Methods and Aids section of the guide those tasks which will be performed with the described tools and materials, the writers leave it to the imagination and material resources of the instructor. Practice is the method by which skill is developed.

1.0 Introduction to the Automobile Mechanics Trade

INSTRUCTIONAL OUTCOMES: The student will be able to identify and briefly explain the history, trends, working conditions, hiring practices, training, employment opportunities and wage scale, as well as working people's benefits and trade terminology.

INTRODUCTION: In order to become an effective worker or make an effective, realistic career decision, an individual must be exposed to various aspects of the trade.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
1.1 History A. At the turn of the century the automobile was an interesting and impractical novelty. B. Motorcar travels in those days was often uncomfortable. 1. Punctures or blowouts occurred every seven or eight miles. C. The pioneer motorist had to make own repairs with own tools and initiative. 1. Breakdowns were frequent.	Explain and Discuss ILS Introduction to the Automobile Mechanics Trade

1.2 Trends A. During the last fifty years or so, the U.S. has had the greatest growth in automobile ownership in the world. B. Average American family drives 10,000 miles annually. C. Total annual mileage for all vehicles, private and commercial, is approximately 767 billion. 1. Privately-owned vehicles account for estimated 82% of total. D. Average owner is estimated to spend $150 each year to maintain car. 1. Estimate does not include purchase of tires or other expenditures. E. Annual revenue from work by auto technicians, repair shops and dealer maintenance shops is over $15 billion. F. There is a serious shortage of service technicians. G. Vehicles have become increasingly complex and require a highly-trained mechanic to service.	
1.3 Working Conditions A. Most mechanics work indoors under well-ventilated, lighted and heated conditions. 1. Some older shops do not offer such pleasant conditions.	Jobsite Visitation Invite Job Specialist

2. Mechanics often work with dirty and greasy parts.
3. Often have to lift heavy parts and tools and work in awkward positions.

B. Minor injuries occur, but serious injuries can be avoided.

1.4 Hiring Practices

A. Employers look for people with mechanical aptitude, manual dexterity and a knowledge of automobiles.

B. Driver's license is required.

C. Reading and studying new developments in automobile mechanics shows interest and an ability to learn.

D. Employers prefer high school graduates who have taken courses in automobile repair, physical science and mathematics.

E. Good health and average strength are essential.

F. Worker must be patient and thorough when working.

G. Customers appreciate honest and reliable technicians.

H. Experienced mechanic will have hundreds of dollars invested in hand tools.

I. Beginning mechanics purchase basic tools and acquire more as they advance.

J. Employers furnish power tools, engine analyzers, other testing equipment.

K. Mechanics generally begin training as general service technicians.

L. Later they may become specialists in the areas of tune-up mechanic, front-end mechanic or automatic transmission specialist.

M. Specialists are often in great demand.
   1. Can command larger salaries.

N. Specialization provides numerous outlets for individual interests and abilities.

1.5 Training

A. Auto mechanics generally learn trade on the job.

B. Trainee can make simple repairs after a few months.

C. Usually takes three to four years to learn all types of repairs.
   1. Another year or two is needed to become specialist.

D. Formal apprenticeships last three or four years.
   1. Training includes on-the-job training and classroom training.
      a. on-the-job training includes basic service and special procedures.
      b. classroom instruction includes mathematics, safety and customer relations.

1.6 Employment Opportunities

A. Mechanic can find employment in any section of country.

B. More than 860,000 persons worked as automobile mechanics in 1978.

C. Job opportunities should be plentiful in the future.

D. More mechanics will be needed as the number of vehicles increases.

E. Mechanics will be needed to service special equipment such as pollution control devices and safety features.

F. Auto mechanics are employed in many departments or areas.
   1. Some are employed by dealerships and repair shops.
   2. Some by gas stations and department stores with automotive service.
   3. Governmental agencies and leasing companies employ mechanics.

G. An independent shop may hire from one to five mechanics.

H. An automobile dealership may employ many of mechanics.

1.7 Wage Scale

A. A 1978 survey showed that skilled automobile mechanics' wages averaged $9.32 per hour.

B. Wage differences occur in different geographical areas.

C. Method of payment causes differences.
   1. Hourly wages based on percentage of labor costs to customer.
   2. Combination of salary and part of labor charges.

D. Employers often guarantee a minimum weekly wage for commissioned mechanics.

E. The skill of the mechanic can double or triple the wages.

F. Most mechanics work from 40 to 48 hours per week.

G. Mechanics receive overtime for any time over 40 hours a week.

H. Some belong to labor unions.

1.8 Common Worker Benefits A. Unemployment Insurance 1. Purpose. a. transition from job to job. b. ease strain of layoffs. 2. Source of benefits. a. payroll tax on wages. 3. Eligibility. a. depends on base year earnings. b. depends on reasons for leaving work. 4. Level of benefits. a. level of base year earnings. 5. Claims process. a. report to Employment Division office. b. provide required information. (1) employer's name and address. (2) your social security number. (3) wage earning records. (4) current address. 6. Appeals/hearing process. a. initiated by worker. b. in writing. c. within time limits. B. Wage and Hour Commission 1. Purpose. a. to investigate and attempt equitable settlement of wage claims. 2. Areas of claim review. a. pay periods. b. pay days. c. final pay days. d. wage payments in cases of dispute.	Explain and Discuss ILS Common Worker Benefits Invite Field Rep Workmen's Compensation Board BOL Wage and Hour Employment Division

e. methods of compensation and overtime.
f. minimum wage laws.
g. limitation of hours in certain industries.
h. restrictions on employment of minors.

3. Jurisdiction.
   a. Federal vs. State.
4. Claim Process.
   a. contact wage and hour commission.
   b. provide required information on appropriate form.
      (1) dates of employment.
      (2) rate of pay.
      (3) reason for non-payment.
      (4) estimate of disputed amount.
   c. wage claim conference.
   d. collection process.
   e. protection against retaliation for filing a claim.
5. Time limits for filing.
   a. regular pay.
   b. overtime pay.

C. Workers Compensation
1. Purpose
   a. provide medical care payment for on-the-job accidents.
   b. provide time loss payments.
   c. provide payments for permanent disability.
   d. provide death benefits.

2. Source of benefits.
   a. employer premiums for insurance.
   b. employee contributions.
3. Level of benefits.
   a. complete for medical costs.
   b. varies according to level of final disability.
4. Eligibility.
   a. any job-related accident or condition causing the worker to leave work and seek medical treatment.
5. Claim process.
   a. report accident to employer.
   b. fill out claim form.
      (1) know your employer's legal name.
      (2) know your employer's insurance carrier.
   c. see your doctor for treatment.
6. Final determination.
   a. doctor's statement of stabilized condition.
   b. board's findings of disability and payment.
7. Reopening claim for aggravation of injury without a new injury.
   a. contact employer's insurance company if occurs within the first five years.
   b. contact worker's compensation board after five years.

1.9 Trade Terminology

A. Common Trade Terms

1. Engine--mechanical device for producing motive power.
2. Intake--supply portion of a system.
3. Exhaust--exit/removal portion of a system.
4. Valve--engine part designed to open and close during combustion cycle to introduce gas/air mixture and remove exhaust.
5. Carburator--divice to mix air and fuel before entering the cylinder for combustion.
6. Alternator/Generator--electrical device used to provide electrical supply for engine and to recharge storage battery.
7. Battery--electrical storage device used to provide electricity when generator/alternator is not in operation.
8. Distributor--contact type or electronic device to send electrical charge to the correct spark plug in the firing order.
9. Points--mechanical device in distributor regulating the flow of current to the spark plugs by opening and closing a circuit.
10. Cylinder--chamber where the combustion process takes place.
11. Radiator--divice for holding a large volume of coolant in close contact with a large volume of air for rapid heat dissapation.

12. Piston--close fitting metal disc moving up and down in a cylinder.
13. Drive train--assembly of parts including engine, transmission drive shaft and differential used to drive the wheels.
14. Filters--devices for removing impurities in oil, fuel and air.
15. Antifreeze--solution of ethylene glycol and water used to keep coolant from boiling or freezing.
16. Freon--refrigerant gas used in air conditioning systems.
17. Timing--adjusting the ignition system to deliver spark to the cylinder at the correct time.
18. Tune-up--process of adjusting the fuel and ignition system to provide optimum operating conditions.
19. Lube-job--process of checking replenishing or replacing the car's lubricants (oil fluids and grease).
20. Allen wrench (hex key)--hex (six-sided) tool often has "L" shape for driving hex type screws and bolts.
21. Torque wrench--tool designed to apply a predetermined level of force to tighten a bolt or nut.
22. Feeler gauge--tool comprised of strips of metal of calibrated thickness used to check clearness between auto parts.
23. Ratchet--drive tool for sockets. Provides rotation of socket without requiring 360^{0} rotation of drive tool. Reversible.

24. Sockets--metal tool designed to fit over head of bolts and nuts to provide firm grip while tightening or loosening.	

2.0 Diagnostic Testing/Automobile Service

INSTRUCTIONAL OUTCOMES: The Student will complete a Specific Aptitude Test Battery (SATB), administered by a qualified examiner and will have the results explained by a qualified examiner.

INTRODUCTION: The General Aptitude Test Battery is a standardized test that has become recognized as the best validated multiple test battery in existance for use in vocational guidance. The tests are used by apprenticeship committees to assist in the screening process for appropriate candidates when apprenticeship openings occur, and to provide individuals with an indication of the probability of their being successful in a particular trade.

Many apprenticeship programs require applicants to have certain aptitudes as demonstrated by passing appropriate tests. For example, the applicant may be required to pass Specific Aptitude Test Battery (SATB) administered by the State Job Service. SATBs test two or more of the following nine general aptitudes: general learning ability (cognitive functioning), verbal aptitude, numerical aptitude, spatial aptitude, form perception (ability to perceive small detail), clerical perception (ability to distinguish pertinent detail), motor coordination, finger dexterity and manual dexterity.

Each battery tests different combinations of these nine general aptitudes because each occupation requires different specific abilities. The following SATB tests and cutting scores are required by the apprenticeship committee for the trade. The student should be aware of the trade requirements and determine how he or she feels about his or her abilities in the tested aptitudes in order to make a career decision.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
2.1 SATB A. Complete exam described below: KEY: Trade Occupation Code # for the occupation SATB for the trade = Recommended cutting	

score for the trade
Location of the SATB within the GATB

AUTOMOBILE SERVICE S#43R
Numerical Aptitude = 75
Arithmetic Reason; Book II, Part 6
Computation; Book I, Part 3

Spatial Aptitude = 95
Three Dimensional; Book I, Part 3

Manual Dexterity = 90
#9 Place, #10 Turn, Board

	Cutting Scores		
	Adult	Grade 10	Grade 9
Numerical Aptitude	80	75	74
Spatial Aptitude	95	94	91
Manual Dexterity	85	79	76

B. Discuss Results:

6.0 Safety

INSTRUCTIONAL OUTCOMES: The student will be able to identify those hazards, acts and conditions which affect safety on the job and will be able to identify ways to avoid or correct them.

INTRODUCTION: A good worker is a safe worker; injury affects production, as well as the ability of a person to earn a living.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
6.1 General Safety A. Average--over 14,000 employees killed each of past several years. 1. From 1960 to 1970 over 150,000 fatalities. 2. Cost, excluding property damage, $11.5 billion. 3. 50 million employee days lost in 1972. B. Accidents 1. An unplanned and unforeseen occurrence that interferes with or interrupts orderly progress of activity.	Explain, Discuss and Demonstrate Where Appropriate ILS General Safety

2. Should be analyzed to determine why and how happened. a. unsafe conditions; poor or defective equipment, poor housekeeping, inadequate lighting. b. unsafe acts; loose-fitting clothing; horseplay, removing guards. C. OSHA 1. Williams-Steiger Occupational Safety and Health Act, 1970. 2. Requires employers to provide safe conditions. 3. Requires employees to comply. 4. Covers about 60-million people; excludes federal employees.	
6.2 Personal Safety A. Safety Consciousness 1. Be aware of good safety practices. a. learn the rules. B. Safety Awareness 1. Put safety consciousness to use. a. obey the rules. C. Head Protection 1. 130,000 head injuries in 1976. 2. Wear clean, adjustable hard hat. D. Eye and Face Protection 1. 1,000 eye injuries each day. 2. Wear safety glasses, goggles, masks; shields if near harsh chemicals. 3. Wear safety glasses under shields.	ILS Occupational Safety-- Personal Safety

E. Hearing Protection
   1. Ear inserts lower high frequency.
   2. Ear muffs lower low frequency.

F. Lung Protection
   1. Mechanical filters protect against non-toxic dust.
   2. Chemical-cartridge types protect against low concentration of some vapors.
   3. Gas masks protect against organic vapers and toxic gases for limited time.
   4. Supplied-air respirators protect against high concentrations of gases and fumes.
   5. Self-contained breathing apparatus protects against high concentrations of gases, vapors, dusts, etc.
   6. Air line respirators protect against high concentrations of dusts, fumes, mists, and low concentrations of gases.
   7. Select proper one for each job.

G. Hand Protection
   1. Average of over 1,300 disabling hand and finger injuries each day in 1976.
   2. Gloves.
      a. asbestos protects against thermal burns, hot or cold.
      b. metal mesh protects against cuts and sharp objects.
      c. rubber protects against electrical and chemical burns.

d. neoprene and vinyl protect against chemicals. e. leather protects against rough objects, heat and sparks. f. fabric protects against dirt, abrasions, slivers. g. coated fabrics protect against chemicals. 3. Creams also used. H. Foot Protection 1. Over 200,000 disabling foot and toe injuries each year. 2. Wear leather steel-toed safety shoes or boots.	
6.3 Fire Types and Prevention A. Fire Types 1. "Class A" of wood, cloth, paper. 2. "Class B" of liquids and gases, paint, grease. 3. "Class C" of energized electrical equipment. 4. "Class D" of metals or metallic dusts. B. Methods of Extinguishing 1. Absorb heat--add water. 2. Smother--add dry chemicals, foam. 3. Remove fuel--shut off supply. C. Fighting Classes of Fires 1. Class A a. water to cool heat.	ILS Fire Types and Prevention

2. Class B. a. CO_2, powder to smother fire. 3. Class C. a. non-conducting agent. b. attempt to de-energize. 4. Class D. a. special extinguishing agent for types of metals.	
6.4 Hygiene Safety A. Exposure to Toxic Materials 1. Can create health hazards. 2. Internal exposure. a. breathing contaminants. b. swallowing contaminants. c. absorption through skin. 3. External exposure. a. contact with skin. b. can affect senses. B. Noise Pollution 1. Measured in decibels. 2. Can affect hearing over period of time. 3. Affects other parts of body. a. changes size of blood vessels, makes heart work faster. b. produces headaches. c. negatively affects nerves, decreases powers of judgment.	ILS Occupational Safety--Hygiene Safety

C. Airborne Contaminants

1. Dusts; particles generated mechanically.
   a. can affect skin, eyes, lungs.
2. Fumes; solid particles of condensation process.
   a. common fumes caused by oxidation of metal.
3. Mists; particles of liquids or liquids and solids.
4. Gases; low density, change to liquids or solids.
5. Vapors; gases normally in solid or liquid state at room temperature.
6. Contaminants may affect body in four ways.
   a. as irritants to lungs.
   b. as asphyxiants, prevent blood from normal transfer of oxygen.
   c. as anesthetics or narcotics, cause drowsiness and nausea.
   d. as systemic poisons, attack vital organs.

6.5 Hand Tool Safety

ILS Occupational Safety--Hand Tools

A. Hammers

1. Face should be 3/8" larger in diameter than object.
2. Strike object squarely and flatly.
3. Replace damaged handles before use.
4. Don't strike wood- or plastic-handled chisels.
5. Don't pound with cheek (side) of hammer.

6. Don't pound sharp objects with mallets

B. Chisels, Punches, Nail Sets
   1. Be sure tools are ground at proper angles.
   2. Remove mushroomed heads.
   3. Hold tools with tongs if being struck by another worker.

C. Screwdrivers
   1. Select correct size and tip style.
   2. Don't pound on screwdrivers.
   3. Don't put hands and fingers under work.
   4. Don't use screwdrivers to pry.
   5. Use appropriate wrench on square-shank screwdriver.
   6. Use magnetized screwdriver to start screws in awkward places.
   7. Use non-sparking screwdrivers if working near explosive hazard.
   8. Use insulated screwdrivers when working on electrical devices.
   9. Don't use screwdriver for electrical testing.

D. Wrenches
   1. Select correct type for job.
   2. Select correct size for snug fit.
   3. Don't use cheater bars.
   4. When using adjustable wrenches, always pull, always against fixed jaw.
   5. Be sure wrench fits squarely, not tilted.
   6. Don't pound with a wrench.

7. Use penetrating oil on "frozen" objects.

E. Pliers
   1. Select correct size and type.
   2. Don't use cheater.
   3. Excessive heat will draw temper from metal.
   4. Don't pound with pliers.
   5. Cutting pliers.
      a. cut at right angle to wire.
      b. point open side down so cut end will not fly out.
   6. Use pliers with high dielectric insulation when working on electrical devices.
   7. Keep jaws clean.

F. Vises
   1. Work as close to vise as possible.
   2. Clamp objects in middle of jaws.
   3. Don't use cheater bar.
   4. Use adequate-sized vise.
   5. Support far end(s) of long work to avoid putting excess strain on vise.

G. Clamping Tools
   1. Select correct size and type.
   2. Keep moving parts clean and lightly-oiled.
   3. Don't over-tighten.
   4. Don't use cheater.
   5. Don't use for hoisting materials.

H. Saws 1. Select correct size and type. 2. Maintain sharpness. 3. Check material before sawing. 4. Use sawhorse or bench, not knee, when sawing. 5. Make sure handle is clean and tight. 6. Be aware of hand, finger and leg position before sawing. 7. Hacksaw teeth should point away from handle to saw on push stroke. 8. Wear gloves when sawing metal. I. Snips, Shears 1. Select correct size and type. 2. Keep blades sharp. 3. Do not cut wire. 4. Use only hand pressure. 5. Wear gloves. J. Files, Rasps 1. Select proper size and type. 2. Don't use wood file or rasp on metal. 3. Cut on forward stroke. 4. Keep teeth clean. 5. Use proper sized handles. 6. Don't use to pry.	
6.6 Power Tools A. Circular Saws 1. Operate only with fixed guard on upper half of blade and flexible guard on lower half; don't tamper with guards.	ILS Occupational Safety--Power Tools

2. Blade should clear material by maximum 1/8".
3. Operate by not forcing; forward motion only.
4. Check material for nails, grit, etc.; support material so it doesn't bind.
5. Allow blade to come to full speed before cutting; prevents kickback.
6. Make sure lower guard has returned before setting down.
7. Clean sawdust from lower guard often.

B. Sabre Saws
1. Select proper blade for material.
2. Feed blade slowly.
3. Hold saw base against material.

C. Pneumatic Tools
1. Secure all hoses.
2. Clean with compressed air only if less than 30 PSI with guard.
3. Hoses over 1/2" diameter must have safety valve at source.
4. Hose couplings must have safety connection.
5. Nailers should have device to prevent ejecting when not in contact with work.
6. Point tools toward floor when carrying.
7. Shut down, turn off air supply, bleed line.
8. Wear safety equipment, goggles, shields, etc.

D. Hydraulic Power Tools

1. Fluid used must be fire-resistant and approved by U.S. Bureau of Mines.
2. Don't exceed manufacturer's pressure recommendations.
3. Don't touch stream of fluid from leak.

E. Compressors

1. Storage tanks must be approved by American Society of Mechanical Engineers.
2. Drain condensed water daily.
3. Tanks must have safety relief valve.
4. Pressure gauge must be maintained accurately.

F. Powder-Actuated Tools.

1. Test before loading each day.
2. Load just before using.
3. Wear hearing, eye protection.
4. Don't point at anyone; keep hands away from barrel end.
5. Leave protective guards in place.
6. Must have safety device to prevent accidental firing, and to prevent firing if tilted.
7. Don't operate near combustion hazard.
8. Should only be operated by trained and qualified personnel.
9. Return tool to case after use.
10. Don't drive fasteners into extremely hard or brittle materials.

7.0 First Aid

INSTRUCTIONAL OUTCOMES: The student will successfully complete an eight-hour multi-media first aid class, taught by a qualified instructor, and will obtain a First Aid Card.

INTRODUCTION: Persons employed in any occupation, especially those occupations which deal with power and hand tools, encounter situations when first aid may be necessary to prevent an injury from becoming more serious. A first aid course, successfully completed, prepares individuals to cope with many of those situations.

PRESENTATION

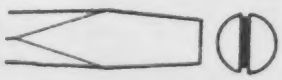
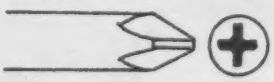
TEACHING OUTLINE	TEACHING METHODS AND AIDS
7.1 First Aid A. Eight-hour multi-media course, or equivalent, offered by: 1. Red Cross 2. Medical Services, Inc. 3. Police Department 4. Fire Department 5. Other service and health organizations.	Administer course

8.0 Auto Mechanic/Trade Tools

INSTRUCTIONAL OUTCOMES: The student will be able to identify and select the tools of the trade and explain their use, as well as demonstrate basic proficiency in their use.

INTRODUCTION: The skilled worker is able to select and use the proper tool for the job.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
8.1 General Tools A. Screwdrivers 1. Blade Phillips 2. Blade is used on a standard screw slot head screw. Phillips has an x shaped point for use with Phillips recessed head screws. 3. Blade & Phillips screwdrivers are hand-held tools that can be rotated right or left and used to remove screws.	Explain and Discuss Invite Supplier to Demonstrate ILS Hand Tool 403-A VIP 403-A, 404-A, 403-B  Blade Tip  Phillips Tip

B. Hammers

Soft Hammer

Ball Peen

Blacksmith

Mallets

Setting Down

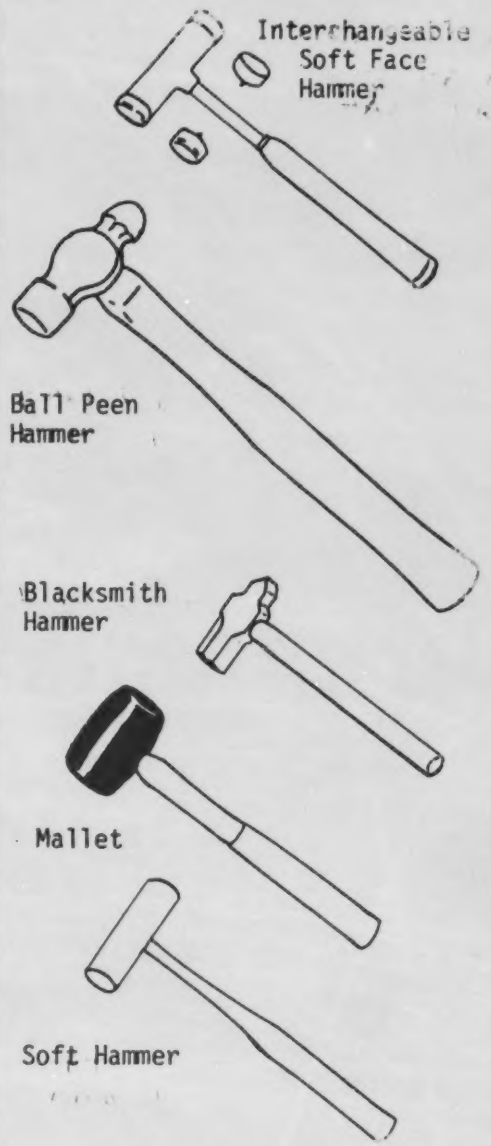
1. Blacksmith hammer--used for forging hot metal; also used where heavy hammering is required.
2. Ball Peen--used generally in the metal and machanical trades. Flat face is used for general work and can have either round peen, straight peen or cross peen heads.
3. Soft hammer--made of lead, brass, copper or plastic. Used to prevent damage to work being struck.
4. Mallets--made of wood, rawhide, plastic or rubber; are used for forming soft metal, pounding finished surfaces or striking machine parts.
5. Setting Down hammer--used mostly for sheet metal work and riveting.
6. Hammers are hand-held tools; it is important that the right hammer is selected in order to prevent damage to parts.

C. Allen Wrenches (Hex Key)

Hex Key

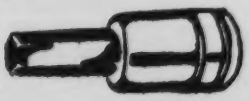
Hex Drivers

1. Hex Drivers--used for driving hex-type screws and bolts where small amounts of twist are sufficient.



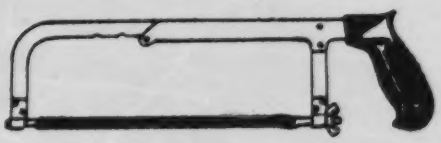
ILS 404-A Specialty Hand Tools

2. Hex Key is used the same as Hex Driver.
3. Tools will deliver much torque and are ideal where speed and space allow.

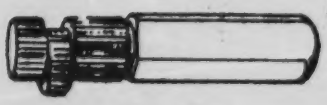


'Hex' Key Socket

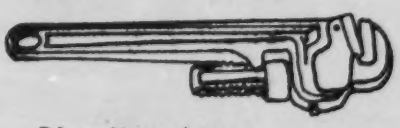
D. Hack Saws
1. Adjustable to accommodate different blade lengths and are made so that the blade can be installed in either vertically or horizontally.
2. To use properly, use a long, even push stroke, with teeth slant forward.



E. Pipe Wrench
1. Use of pipe wrench is to turn pipe or round stock; adjustable.
2. Is for gripping pipe or other round surfaces (not to be used on nuts or bolts)
3. Jaws have grip teeth and are self-tightening as pressure is applied to the handle.

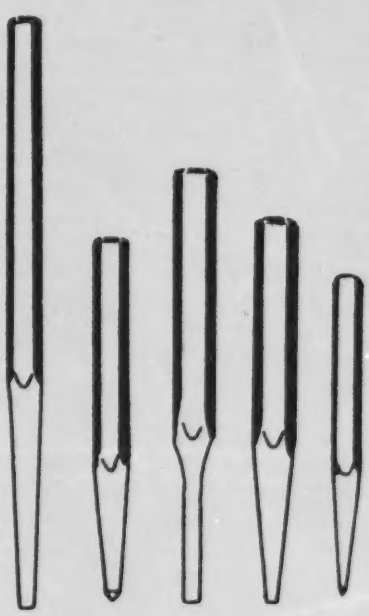


Inside Pipe Wrench



Pipe Wrench

F. Punches
Center
Prick
Pin
1. Center punch--used for locating centers for drilling holes in metal.
   a. to use, place punch point in area marked for drilling and strike end with ball peen hammer.
2. Prick punch--is used for layout work on sheet metal. Punch should be kept sharp and ground to 30^{0}.
   a. use is same as center punch but



Punches

with one-half the striking force to the punch.

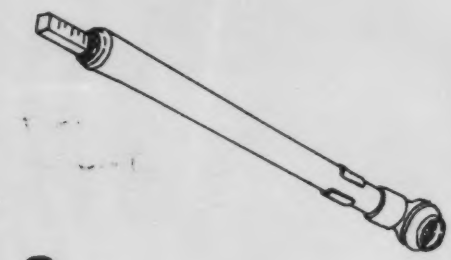
3. Pin punch--is used to drive out pins and collar keys.
   a. punch has a long, straight shank, the diameter of which designates the marked size. Used in same manner as other punches.

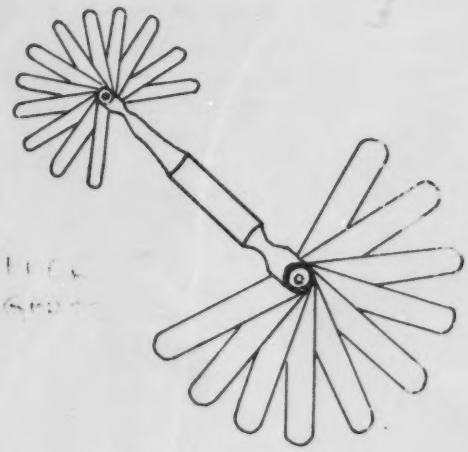
G. Tire Gauge
   1. A tool used for measurement of tire pressure (PST). (Each make of tire has the amount of pressure required expressed on side of tire.)
   2. To use, remove pressure valve cap, place gauge over valve, press, read pressure at end of gauge.

H. Torque Wrench
   1. Used for tightening some nuts and bolts which have been tested for strength and require a set torque. (wrench is used in conjunction with manufacturer recommendations.)
   2. To use, preset torque required, apply pressure until arrow reaches setting.

I. Feeler Gauge
   1. Used for setting gaps for spark plugs.
   2. Use is determined by setting referenced in auto owners' manual.
   3. Place feeler in gap of spark plug and adjust gap until feeler pulls out with a slight drag.

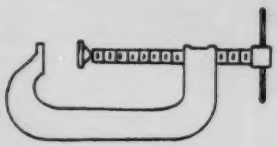
ILS 3011 Auto Tires





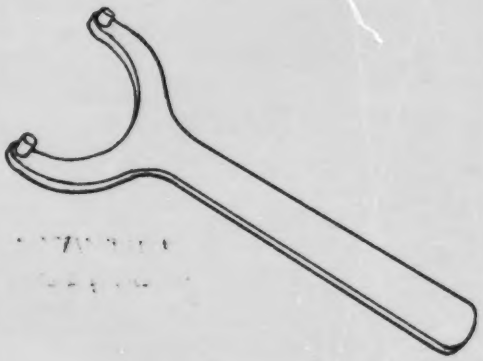
J. C-Clamps

1. Clamping devices used for clamping together or clamping down work for repair. (tool is known as the 3rd hand) To use, clamp to table and hold a part or clamp parts together.



K. Spanner Wrench

1. A special wrench which engages slots or holes in a nut.



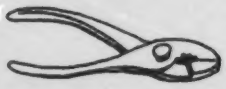
L. Pliers

Needle Nose
Combination Slip Joint
Diagonal Pliers
Flat-nose Pliers
Utility Pliers (channel-lock)

1. Needle nose--used for holding and forming medium sized materials.
2. Combination slip joint, general purpose plier--provides good gripping power, combination jaws that provide for gripping flat surfaces at the jaw tips and round surfaces at the jaw base. Some have wire cutting edges at base of jaws.
3. Diagonal pliers, also called side-cutting pliers--used to cut small round material such as wire and cotter pins.
4. Flat-nose pliers--used to grip flat material when damage to material must not be risked.
5. Utility pliers, also called "water-pump" or channel-lock pliers--used where object to be gripped is beyond the size of combination plier range.

VIP 403-A

Needle Nose



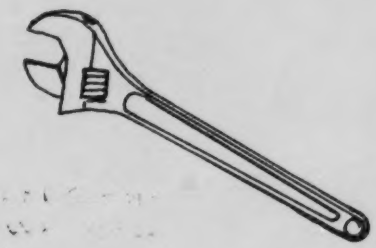
Combination Slip Joint

Flat Nose

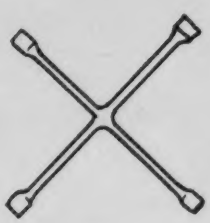
Side Cutting Pliers

6. All pliers hand operated--close jaws by gripping handles and squeezing tightly on object.

M. Adjustable Open-end Wrench; also called crescent wrench.
   1. Used as a multiple-purpose tool. (Use should be limited to field applications where carrying several sizes would be inconvenient.) Available in lengths ranging from 4" to 14" and jaw sizes ranging from ½" to 1½". (Due to their inability to retain size adjustments, they are slow and unhandy to use. Also when large pressure is applied, they have a tendency to slip.)
   2. Wrench is used by adjusting jaw opening to fit object to be turned by turning screw in stationary part of jaw. Tighten jaws tightly on object and exert pressure against stationary jaw.



N. 4-Way Lug Wrench
   1. Wrenches available in various sizes.
   2. Used to remove and replace lug bolts or lug nuts attching wheel to vehicle.
   3. Select proper size to fit vehicle lugs, turn wrench by hand to remove and replace lug bolts or lug nuts.

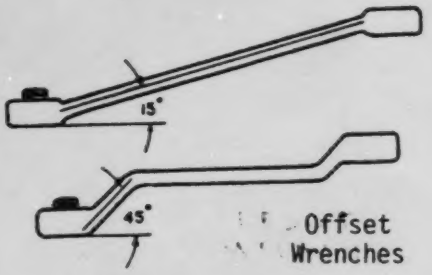


O. Combination Wrenches
   1. Non-adjustable wrenches have a box wrench or closed end and an open wrench at the opposite end. Both ends are same size. Sizes in U.S. increments of 1/16" are available from 1/16" up to 2" or more. Metric sizes in increments of 1 millimeter range similar to U.S. starting at 2mm and up to 28mm or more.
   2. Wrench is fitted over nut or bolt, turned.

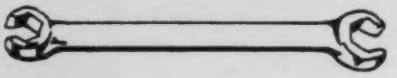
P. Open-end Wrenches
   1. Non-adjustable wrenches that are double-ended with two different size openings.
   2. Openings are angled with the wrench body so they can be used in close quarters.

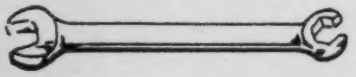
Open End Wrench

Q. Box Wrenches
   1. Available in same sizes as open-end wrenches; different sets have straight or offset openings.
   2. Wrench body completely surrounds the bolt head or the nut; preferred over other wrenches because it will not slip.



Offset Wrenches



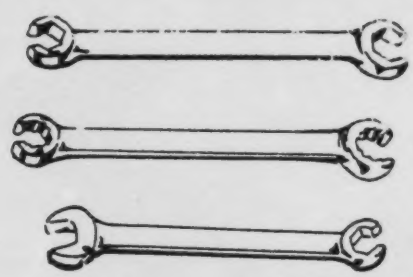


R. Flare-nut (Tubing Wrenches)
   1. Come in 1/16" increments and 3/8" - 7/16" - 1/2" - 9/16" - 5/8", the most common sizes used in auto-service repair.

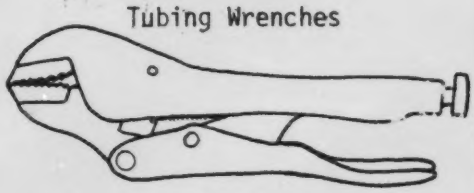
2. Specialized wrenches used to tighten & loosen brass and aluminum fittings on copper and steel fluid, air lines; are only partly open-end, but are wider to prevent slipping and damage to fittings.

S. Lever-jawed Wrench
   1. Adjusted by screw in handle; hand tightening closes jaws with multiplied power; toggle action in handle tripped to release jaws.

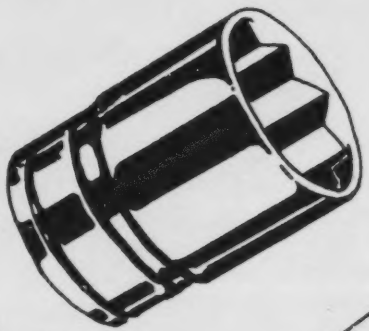
T. Socket Wrench Sets
   1. Available in sizes in increments of 1/16"; common sizes range from 3/8" to 1". Mechanics' socket sets, of chrome or polished finish, usually include "drivers" to turn sockets adaptable to various sizes.
   2. Used by turning with a ratchet, speed wrench or breaker bar.
   3. Drivers, 1/4" - 3/8" and 1/2"; (also 3/4" and 1" drive sizes, but are not commonly used by most mechanics.)
      a. ratchets, 1/4" - 3/8" - 1/2"; drive reversible button allows ratchet to advance in either direction.
      b. breaker bar, 1/4" - 3/8" - 1/2"; drive handle has hinged drive part, allows clearance over obstruction when turning socket.



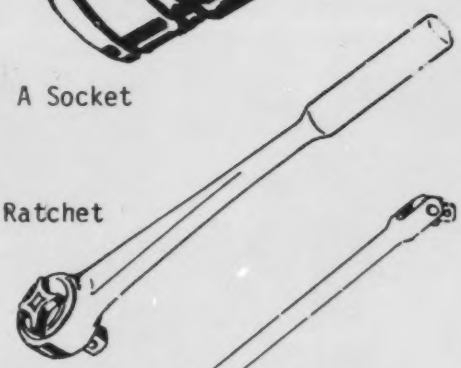
Tubing Wrenches



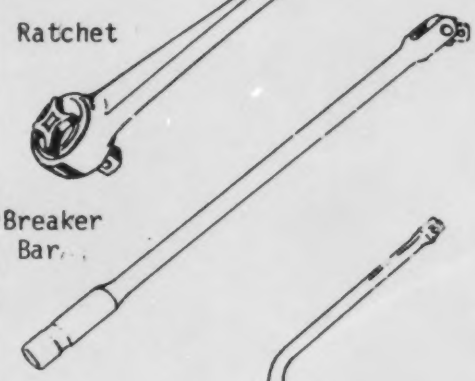
Lever Jawed Wrench



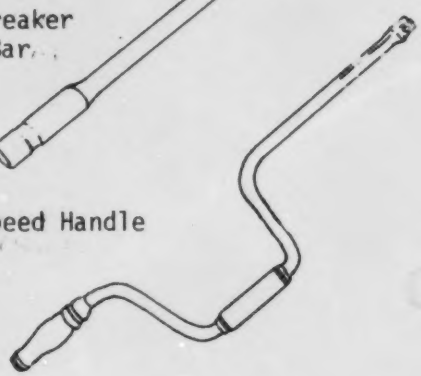
A Socket



Ratchet



Breaker Bar



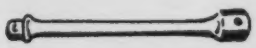
Speed Handle

c. extensions, 1/4" - 3/8" - 1/2"; extensions allow sockets and various drives to be used to gain access to nuts and bolts that otherwise could not be reached or turned with other types of wrenches.

4. Special sockets
   a. impact sockets--of heavier-bodied and stronger material to prevent damage or breakage. Usually dull appearance.
   b. spark plug sockets--special sockets deep enough to reach hex on spark plug, may contain rubber insert to aid in holding spark plug in socket.
   c. six- and twelve-point sockets; most sockets are twelve point; to prevent damage to nut or bolt six-point sockets are used, prevent slipping.
   d. midget socket sets--usually 1/4" drive; contain sockets for extremely small, fine work; sizes vary from 1/8" to 7/16" in increments of 1/64".

U. Spark Plug Ratchet
   1. Usually 3/8" drive with reversing button; has hinged handle to aid in gaining access to spark plugs in some applications that would be difficult with standard ratchet or breaker bar.

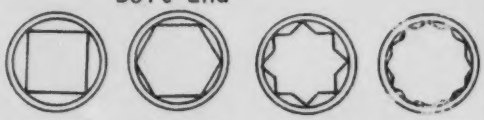
Bar Handle Driver



Extension

Sockets

Bolt End

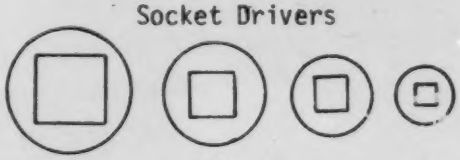


4 PT. 6 PT. 8 PT. 12 PT.

Spark Plug Socket

Impact Socket

Socket Drivers



3/4" 1/2" 3/8" 1/4"

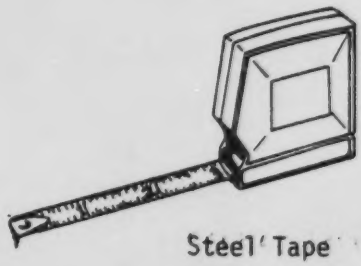
Spark Plug Ratchet

8.2 Measuring Tools

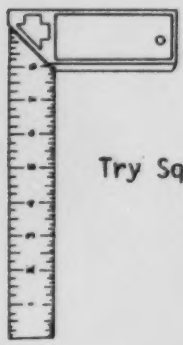
A. Steel Tape
Steel Rule
Try Square
Combination Set

1. Steel tape--used for measuring distances, material and objects.
   a. tape is made of thin steel and will break or kink if stepped on; should be kept free of dirt and dust.
2. Steel rule
   a. used as a measuring and layout tool; has increments which range from whole inches to as small as 1/16-inch.
3. Try square
   a. a six-inch square (per side) tool, used for measuring short distances and for checking pieces to check square or right angles.
4. Combination set
   a. consists of blade (rule), square head and center head for finding center of round stock, and bevel protractor graduated in 180^{o}.
   b. sliding tee bevel square is used for duplicating and transferring angles.

ILS Measuring Tools

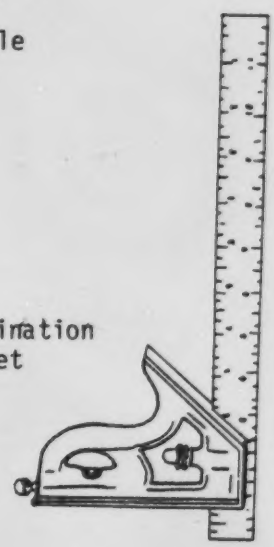


Steel Tape



Try Square

Steel Rule



Combination Set

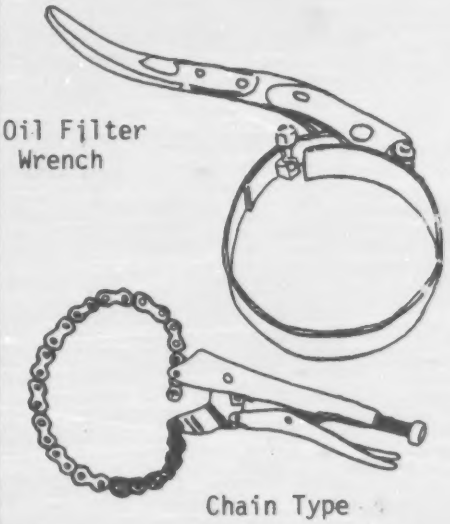
8.3 Other Tools and Equipment

A. Oil Can Spout

1. Metal spout.
2. Spout is used to pour oil out.
3. Pushed into the oil can top, cutting the opening and attaching self to can.

B. Oil Filter Wrench

1. Band type
   a. used to remove spin-on type filters.
   b. band is placed around filter body and turned by handle.
2. Chain type
   a. similar to band type but has chain to encircle filter.
   b. used in same manner.
   c. do not use filter wrench to tighten filter; always tighten filter by hand.

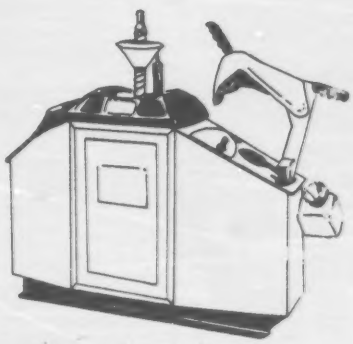


Oil Filter Wrench

Chain Type

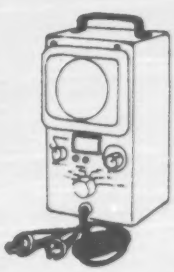
C. Tire Changing Machine

1. A pneumatic operated machine for removing and replacing tires on wheel rims.
2. Follow manufacturers' guide for individual machines.



D. Oscilloscope

1. Several manufacturers provide these machines. (Sun, Heath, Allen, Marquette.)
2. An electronic diagnostic machine. Electrical leads attach to the vehicle's ignition system. By comparing them with a known correct waveform, can determine if corrections,



adjustment, replacement or repairs are needed.

3. Follow manufacturers' guide in hooking up and use of scope.

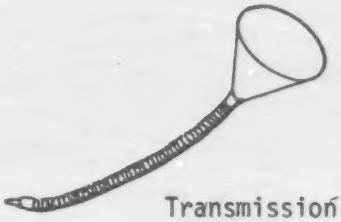
E. Lubrication Tools (Lube Gun)

1. Pneumatic--a source of air pressure is needed, the end of the gun is pressed firmly on grease fitting. When handle is squeezed grease is forced by the air pressure into grease fitting.
2. Hand operated--handle is pumped and grease is forced by pressure into grease fitting.

Hand Operated Grease Gun

F. Fluid Dispenser--a gun which contains controls that are set to determine amounts dispensed; air pressure forces fluid through dispenser when handle is squeezed. May contain shut-off valve at nozzle end to prevent accidental discharge or leakage.

G. Transmission Funnel--a funnel with extra long nozzle to aid in reaching automatic transmission fill pipes which provide limited access.



Transmission Funnel

H. Credit Card Machine--used to imprint and record sales by pressing credit card on sales slip.

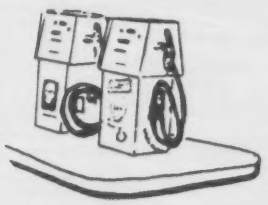
I. Gasoline Dispensing Pump--measure amount of fuel dispensed and auomatically computes price for total amount. Records accumulated amounts dispensed, for inventory purposes.

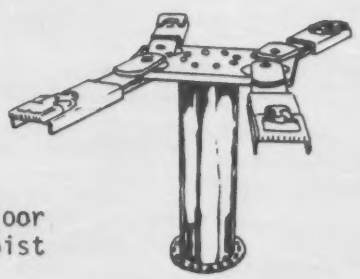
J. Cash Register--machine operated by electricity. Push buttons indicate dollar and cents on record paper tape; amounts can be seen on face of machine as printed on paper tape.

K. Calculator or Adding Machine--electric or electronic machine that adds, subtracts, and does other functions depending on design. Speeds up mathematic problems with higher degree of accuracy.

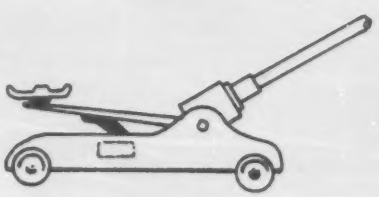
L. Car Hoists
   1. Various manufacturers build machines. Some machines raise by frame contact and others by axle or wheel. Vehicles should be raised on appropriate hoists to be able to gain access to those components that require service or repairs.

M. Floor Jack
   1. Four-wheeled device, rolled under car. Handle is pumped to raise vehicle.
      a. Should use jack stands, used by placing under car before working beneath car. Adjustable to convenient height.

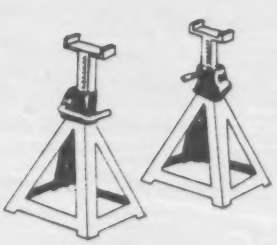




Floor Hoist



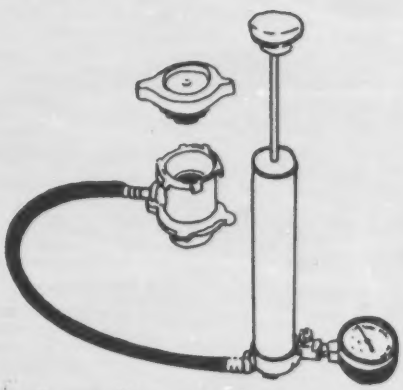
Floor Jack



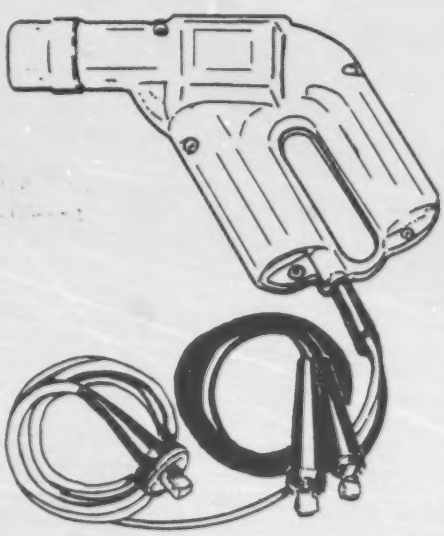
Jack Stands

N. Compression Gauge
   1. Device used to measure engine cylinder pressure in determining engine condition.
   2. Used by inserting into spark plug hole and cranking engine at starter speed.
   3. Readings of cylinder pressure can be recorded and used as comparison when making diagnosis.
   4. Follow manufacturers' procedures.

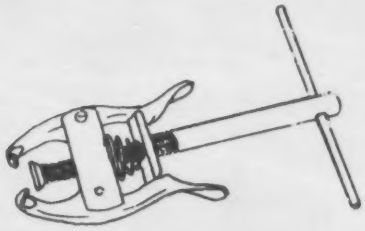
O. Radiator Pressure Tester--a tool used to place in radiator filler neck to check for leaks.
   1. Pressure is pumped by hand to amount specified by manufacturer.
   2. Cooling system components are then inspected for leakage. An adapter is available to allow pressure testing on the radiator cap.
   3. Follow manufacturers' guide and auto specifications.



P. Timing Light (Stroboscopic Type)--an electronic light that is attached to spark plug wire, flashing each time cylinder fires.
   1. Light pointed at vehicles timing mark so that the light illuminates the marks.
   2. Vehicle timing can then be determined and adjustments needed if required.
   3. Follow manufacturers' recommended procedures.

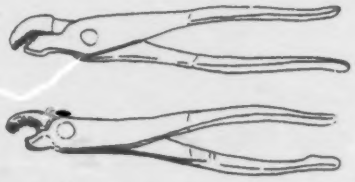


Q. Battery Terminal Puller--a special clamp puller used to pull the battery cable clamp from the battery terminal.
   1. Follow manufacturers' recommendations.



Battery Terminal Puller

R. Battery Pliers--special non-corrosive pliers used to loosen battery cable clamp bolts when corrosion has damaged clamp bolts.
   1. Use like any pliers.



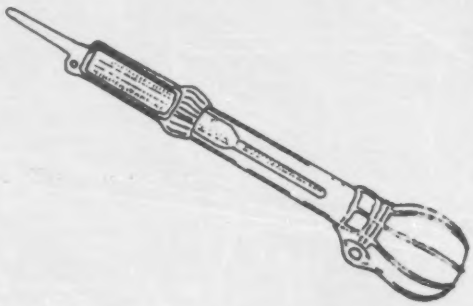
Battery Pliers

S. Battery Chargers
   1. Quick-charge system--cables from battery charger are attached to battery terminals; charger is plugged into electrical outlet. Charging time ranges from minutes to 1½ hours.
   2. Slow-charge system--battery is usually removed from vehicle and charger attached. 2 to 72 hours is usual.

T. Battery Filler Bottle--a special plastic container used to dispense battery water; special design filler spout prevents overfilling and spillage.

U. Hydrometer
   1. A measuring instrument used to test specific gravity of various liquids. In a battery, specific gravity of electrolyte is measured to determine state of change in battery.

VIP 803-A



2. In cooling system, specific gravity of anti-freeze solution is measured to determine if cooling system is protected.
3. To test battery, unscrew and remove cell caps from top of battery.
4. Insert hydrometer in cell and read specific gravity.
5. Leave hydrometer tube in cell and read temperature of the electrolyte.
6. To test cooling system, warm engine up to operating temperature.
7. Draw coolant into hydrometer and squish back into radiator four or five times to bring hydrometer to cooling system temperature.
8. Leave anti-freeze in bulb and take reading if hydrometer has float, allow all air bubbles to bleed out.

V. Squeege--a long handled push broom shaped with a rubber wiping lip that can push liquids on smooth floor; for cleaning up spills; aid in removing unwanted liquids from surface area.

Floor Squeege

8.4 Hand-held Power Tools (Electric and Pneumatic)

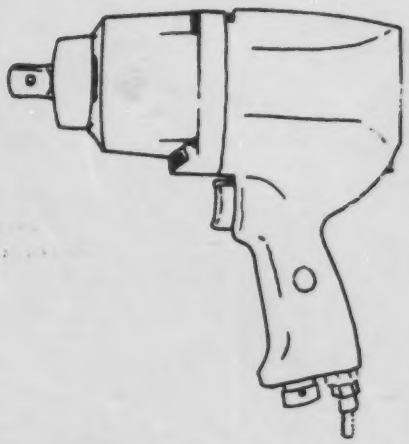
ILS Portable Power Tools

A. Hand Drill

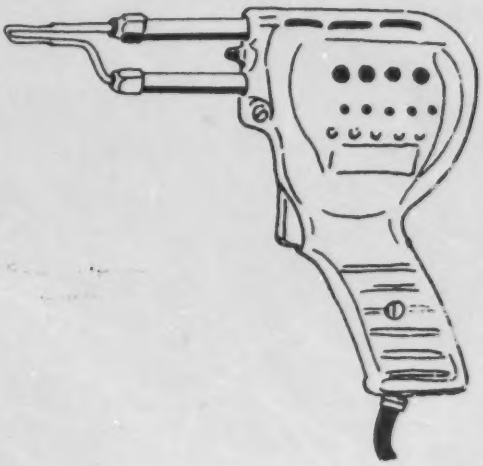
1. Designed for drilling holes in wood or metal; many types of hand drills and accessories that can be used for different jobs.

2. Sanding, buffing, polishing, screw-driving, and paint mixing are possible uses.
3. Attach proper accessory.

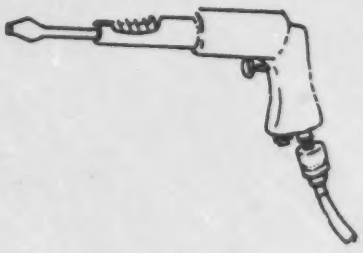
B. Impact Wrench
1. A portable hand type reversible wrench with square impact driving anvil over which square drive sockets can be fitted.
2. Used for tightening nuts and bolts, in conjunction with socket; air or electric operated.



C. Soldering Gun
1. An induction-type soldering iron.
2. Main use is for soldering electrical wires.
3. Gun operates on dry standard electrical outlet and is rated in size by number of watts produced; relies on acid core wire.



D. Chipping Hammer
1. A steel piston which is reciprocated (moved back and forth) in a steel barrel by compressed air. On its forward stroke the piston strikes the end of the chisel, which is a sliding fit in a hexagon nozzle pressed into the barrel.
2. Used for beveling, caulking or beading operations, also drilling through concrete, masonry.



3. Reciprocation of the piston is automatically controlled by valve box assembly located in the rear end of the barrel; on rear end of barrel is grip handle containing poppet-type throttle valve.	

3.0 Survival Skills/Auto Mechanic

INSTRUCTIONAL OUTCOMES: The student will learn and practice fundamental concepts in: a) dealing with expectations, b) communication skills, c) giving and receiving feedback, d) dealing with interpersonal conflict, e) group problem-solving, goal-setting and decision-making, f) outside influences and responsibilities, g) identifying individual strengths, h) appropriate work habits and attitudes, and, i) phases of job search and worklife.

INTRODUCTION: Training and proficiency in human relations skills are essential for successful adaptation to worklife. All too often in job preparation programs, these basic survival skills are neglected or put aside in favor of training in the technical aspects of work.

This topic describes the many skills necessary to become a stable, productive and satisfied worker.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
3.1 Expectations A. Predicting the future 1. Self-fulfilling prophecies a. setting yourself up for failure b. thinking positively	ILS Survival Skills-Expectations PREPARATION Be familiar with the material beforehand, and think up some relevant examples AVAILABILITY Be available to students. Go around those students reading the material. Be prepared to answer and ask questions that increase students' understanding.

	ELICIT RESPONSE Ask individuals what they would like to do most of all. Use their reply even if it seems trite. Suggest two alternative possibilities--the worst and the best. Ask how each would affect that student's feelings and behavior at this moment.
B. Two-step process to opening up expectations.	
1. Being idealistic and realistic	
a. being creative and having ideas	RELEVANT COMPARISONS Illustrate creativity from movies, TV or writing. Tell the beginning of a story and ask for suggestions on how it might end. Give the original writer's version. Show how anything is allowed in creative ideas.
b. keeping close to the facts	Suggest students read court reports or news coverage.
c. effects of leaving out one of the two steps.	STUDENTS' EXAMPLES Encourage extreme examples of fantasy and of sticking close to the facts.
d. combining the two	
C. Prejudice about other groups.	EXAMPLES OF PREJUDICE Show how stereotypes arise out of stereotyped expectations.
D. Being a winner	ROLE MODEL Be heard thinking positively. Encourage positive thinking in students.

E. Self-Assessment--looking at common personal expectations F. Post Assessment	IDENTIFY PROBLEM AREAS Go through questions to see where students are putting themselves down. Give encouragement. Ask what they want to change. EXPLAIN Read through examples, answer questions. FLEXIBILITY Allow students to demonstrate their understanding in less than suggested number of situations.
3.2 Communication Skills A. Good communication 1. two-way process 2. importance 3. innate abilities 4. showing mutual respect	ILS Survival Skills-Communication Skills. PREPARATION Be familiar with the material. BEING A ROLE MODEL Demonstrate active listening. Ensure that students voice problems and doubts. Allow frequent opportunity for students to give responses to on-going work. Be ready to demonstrate bad examples of listening, to group or individuals, and contrast with good examples.
B. Active listening. 1. Centering attention on the other person. a. being seen to be listening b. finding out what is important to the other person c. following the other person's lead d. listening to feeling 2. Checking that you have understood what the other person is communicating. a. checking feeling	

b. checking content c. when it is inappropriate C. Being listened to. 1. Your rights as an individual 2. When to keep quiet 3. Avoiding being aggressive 4. A three-step approach a. showing you understand b. taking responsibility for your own feelings c. suggesting alternatives D. Overall importance of respect for individuals 1. Communication between equals E. Self-Assessment 1. How individuals communicate with others F. Practicing the skills in triads 1. Active listener of personal experience 2. Role play being listened to	ASSERTIVENESS Draw examples from books on being assertive. Think up appropriate examples in work context. Discuss aggressive responses with individuals. Describe alternative approaches. Discuss possible exceptions--where aggression might be appropriate. INSTRUCTOR/STUDENT RELATIONS Assess relations in class in terms of respect for, and equality of, individuals. Ask students for comments. IDENTIFY PROBLEM AREAS Give help and encouragement. Find out from students what skills they want to practice. TRIADS Form triads (trios) as students finish Self Assessment. FEEDBACK Listen to one example of active listening in each triad. Give suggestions for improvement. Be open to alternative situations for the role play. Ensure students are willing to practice being sensitive to possible reluctance and shyness. Be prepared to role play yourself.

3.3 Giving and receiving feedback A. Importance of being able to give praise and criticism (introduction).	ILS Survival Skills-Giving and Receiving Feedback PREPARATION Be familiar with the material and prepared to participate actively and equally.
B. Importance of group support and teamwork 1. Being a team member 2. Building a team a. knowing where you are b. pulling your weight c. responsibilities for others d. group aims and goals 3. Poor working environments a. indirect communication b. not knowing where you stand	FACILITATION Facilitate continuously the building of group support. Give extra support to students who have difficulties participating fully. Enlist help of more confident and verbal to share the responsibility. Give support, but principally be a neutral chairperson or facilitator.
C. Reading attitudes 1. Hired or fired? 2. How do you come across to other people? 3. Interpreting other people's behavior	Encourage group members to observe each others' non-verbal behavior between class times.
D. Giving and receiving positive opinions 1. Importance of praise 2. Taking compliments 3. Giving praise	POSITIVE REINFORCEMENT Give frequent verbal praise to individuals who are working well and to the group as it becomes more supportive
E. Getting and giving criticism 1. Its importance 2. Being criticized 3. Avoiding being threatened 4. Between equals	
F. Self Assessment-Feelings and Preferences	MONITORING Walk around and ask permission to join in some partner discussions. Encourage greater depth. Avoid any judgments. Use paraphrase

	and feeling as checking skills
G. Assignments	
1. Telling individuals what you like	A DEVELOPING PROCESS Introduce when group is ready. First three assignments could be practiced even before module has been read. Explain, in turn each assignment to whole group. Deal with worries, doubts or questions before you begin.
2. Reading attitudes within the group. 3. Opening self-sharing important experiences	Use all your facilitating skills. Especially be sensitive to members' non-verbal responses. Follow up, after the class, on any individual who is upset. At all times encourage positive support within the group. Be prepared to intervene if criticism becomes too negative
4. Receiving direct positive feedback 5. Receiving direct positive and negative feedback	
H. Post Assessment	Organize small groups or lead discussion of whole group. Use small groups to extend each individual's range of interactions.
3.4 Dealing with interpersonal conflict	ILS Survival Skills-Dealing with Interpersonal Conflict
A. Consequences of poor interpersonal relations	PREPARATION Be familiar with the material and ready to supply further relevant examples from the

3. The four-step language formula. a. tell the other person that what he or she is doing is upsetting you b. speak your feelings c. describe how his or her behavior is affecting you d. suggest an alternative H. Negotiating 1. Give and take 2. Compromise I. Discrimination and prejudice 1. Different types 2. Dealing with it	IDENTIFY IMPORTANT GROUP ISSUES Deal in a neutral manner with examples of discrimination. Ask individuals for personal experience of racial and sexual prejudice and discrimination. Facilitate discussion on Equal Opportunity and Affirmative Actions. Invite solutions to problems from group members.
J. Self Assessment	NEW ISSUES Be aware of any controversial issues that arise during the Self Assessment. Introduce them to the group for general discussion.
K. Assignments 1. Sharing in small groups.	ORGANIZE GROUPS Form groups as students finish writing. Limit talk to five minutes on each topic. Maintain some urgency by announcing the five minute intervals.
L. Post Assessment 1. The formula	COLLECT WORK Read and make encouraging

2. Personal examples	written comments. Arrange contract for completion of work with any students who produce low standard work.
3.5 Group Problem Solving, Goal Setting and Decision-making A. 10-step model 1. Define the problem 2. Look at the known facts a. what is happening b. who is involved c. when does the problem occur d. where does it occur e. why has it become a problem 3. Agree on your goals 4. Pool ideas for achieving your main goal without evaluating them 5. Look more closely at some of the more interesting and unusual ideas 6. Include any other ideas that you think might be helpful 7. Agree on some guidelines for achieving your goal a. be specific about minimum behavior required 8. Decide on a plan to implement your proposed solutions 9. Assess the likelihood of success 10. Evaluate the success of your decisions after they have been implemented. B. Self Assessment	ILS Survival Skills-Group Problem Solving, Goal Setting and Decision-Making PREPARATION AND MATERIALS Know the 10-step model without having to refer to it on the page. Work through the process beforehand. Have photocopies of the model. Have ready one large newsprint pad and one marker for every five students. Choose about six examples of unusual tools or materials that students are unlikely to have seen. Have them ready, but hidden. Get advice from specialists beforehand. AVAILABILITY Go around students in class while they are reading material. Help them understand the 10 steps. CHECK LACK OF UNDERSTANDING Look over individuals' answers. Give help for misunderstandings.

C. Assignment in small groups 1. Producing quality of ideas 2. Practice in thinking creatively	MATERIALS REQUIRED Sheets of newsprint and sufficient markers ARRANGE GROUPS During these assignments, there may be laughter and a lot of excited talk. Encourage composition of groups on basis of who works well together rather than primary friendships. Keep groups separated by space. Go around groups, sit in and participate. Keep up speed of work by giving limited time to gather ideas. Invite spokesperson from each group to report back on ideas. Write down ideas as they are given and summarize range of proposed solutions.
3. Identifying unusual objects.	OBJECTS REQUIRED Supply one object for each group. Choose trade tools or materials that most students are unlikely to have used.
4. Quality circle	MONITOR PROGRESS Encourage written records of proposed solutions. Ensure all members of each group take some responsibility for finished product. If possible, get results typed out so they can be shared within larger group.

D. Post Assessment	PREPARE HANDOUT Have copies of 10-step model. Make sure students check what they have written and correct it. PERSONAL EVALUATIONS Invite students to read out or tell others what they wrote under 2 in the Post Assessment.
3.6 Wider influences and responsibilities A. Relations with people in authority 1. Formal workplace a. job titles b. hierarchy 2. Informal workplace a. unwritten rules and unstated expectations 3. Showing respect and being relaxed	ILS Survival Skills-Wider Influences and Responsibilities PREPARATION Be familiar with the module and gather useful newspaper cuttings, brochures and leaflets that illustrate the range of possible influences on somebody settling down to work. BE A READY RESOURCE Give examples informally to students from personal experience to back up information. DRAW ON STUDENTS' EXPERIENCE Encourage individuals to think of relevant illustrations from their own experience in a work setting.
B. Relations with family and friends 1. Changes in responsibilities 2. Affects of changes on old relationships a. being prepared b. communicating problems 3. Planning quality time a. keeping work problems at work b. maintaining relationships	

4. Keeping up leisure activities 5. Home problems at work a. leaving problems at home b. serious problems C. Other influences 1. apprenticeship 2. union 3. social organizations 4. other workers 5. state and federal agencies D. Self Assessment	SUPERVISION Ask students to show their answers to the Self Assessment. Since it is a test of comprehension, follow up on any difficulties revealed.
E. Assignment	CHOOSING PARTNERS Encourage students to work with someone different each time. After majority of students have completed assignments, hold a report-back session with whole group. Ask students to summarize and draw conclusions from reports given.
F. Post Assessment	DEMONSTRATE Show what is required by illustrating it on a chalkboard.

3.7 Identifying and developing individual strengths A. Evaluating yourself and others 1. Expectations 2. Personal theories a. predicting b. controlling B. Identifying personal values 1. Significant role models 2. Eliciting personal constructs 3. Bi-polar nature of constructs	ILS Survival Skills-Identifying and Developing Individual Strengths PREPARATION Work through module beforehand. Acquaint yourself with any areas that might cause difficulties in understanding. Make extra copies of exercise sheets. Refer to ILS Expectations. AVAILABILITY Be at hand throughout this module. For students to discover significant things about themselves, instructions must be followed closely. Ensure that students have had a personal relationship with each of people listed in right column. Ask them to put names they used to address these people. Check students' understanding of procedure. If necessary, go through method with whole group. Ensure that the description is of importance to each student and not superficial, such as hair color, etc. Stress that there is no correct answer; it is important for each person to write what seems opposite to him or her personally regardless of what anyone else might say.

4. Identifying important personal values	ARRANGE PARTNERS Go around and offer interpretations if requested or encourage students to draw conclusions. Ask what they recognize and what is new.
5. Evaluating yourself. a. as you feel you are b. as you would like to be c. looking at the amount of congruity	DISCUSS WITH INDIVIDUALS OR SMALL GROUPS Be tentative about what is identified. The conclusions can only be significant if the individual finds them significant. Use words and phrases such as..."it seems...," "you may..." "I would guess...." "it might indicate..." Use grid to prompt questions rather than answers.
6. Evaluating significant others a. comparing ratings	IN PARTNERS Suggest each student in turn tries to describe what people the other one might like and what people he or she might not like, based on the constructs on paper. Ensure that students follow instructions closely. Encourage them to search for all influences. If they have difficulty, suggest situations where students make choices, e.g. career, friends, classes, out-of-school activities.
C. Influences on personal decisions 1. How much are you in control of your own life? 2. Positive and negative influences. a. other people b. aspects of self c. organizations	

D. Time management 1. Organizing skills 2. Being responsible for your own life 3. Prime time 4. Making a time chart a. procedure b. interpretation	EXTRA COPIES Have ready prepared extra copies of time chart Ensure agreement on completing time chart. Go over method of calculating actual time. Illustrate on chalkboard or newsprint paper; give example of one day's record. Use tally system. CHECK STUDENTS' UNDERSTANDING Do this before anyone starts recording. It might be advisable to go over procedures one day ahead and practice be done in class.
E. Post Assessment 1. Personal values 2. Influences 3. Use of time	Collect, read and hand back during class. Give encouraging comments.

3.8 Worksite Visits A. Building realistic expectations 1. Questioning job descriptions 2. The human side of the job 3. On-the-job visits 4. Talking with people in the trade B. Group visits 1. Exposure to different working environments 2. Practice in observation 3. Asking questions C. Individual visits 1. After working hours 2. Interviewing the worker 3. Arranging the visit D. Self Assessment-Comprehension E. Assignment 1. Looking at Help Wanted ads	ILS Survival Skills-Finding a Job Worksite Visits PREPARATION Arrange with any company that allows it a group visit during working hours. Have sufficient copies for use by whole class of Help Wanted ads from local newspapers. Become an informed source of possible contacts for student interviews with journeymen and apprentices. CHECK UNDERSTANDING Ensure students comprehend all of the material before making any contacts or visits. HELP WITH ASSIGNMENTS Supply Help Wanted sections--one to each student. Suggest they read through and circle in ink interesting ads. Stress importance that each works on his or her own; it is practice in looking for jobs. Collect what students write and report back

	to whole group with summary of students findings.
2. Writing realistic job descriptions.	Read and comment on students' descriptions. With individual's permission, read out selection to whole group and invite comparisons with job descriptions in newspaper.
3. Contacting a journeyman or apprentice	Supply names and encourage students to come up with own contacts. If necessary, two students could team up to make a visit.
	Role play telephone contact and get students to copy out suggested questions. Make individual contract with each student, setting deadlines to call, to visit and to report back. Check on progress and share with rest of group.
4. Asking questions	Arrange for individuals to report back to whole group at same session.
5. Making a group visit	Go over observations and questions beforehand. Ask students to write questions down. Divide questions, and order of asking, among group. Add any other questions suggested by group.
6. Reporting back	Ensure that each student records his or her observations. Invite individuals to report on their feelings and findings.
7. Discussion	Lead group discussion on overall findings.

	Arrange another worksite visit.
3.9 Resumes A. Nature and function 1. Self advertisement 2. Summary of strengths and skills 3. Different ways to use resumes 4. Contrast application forms B. Extracts from resumes 1. People with little work experience 2. Presenting the best interpretation of the facts C. Suggested format 1. Position desired a. finding out about the job b. matching your skills 2. Education 3. Relevant work experience 4. Other relevant experience 5. Personal data 6. References a. making a list of your achievements D. Identification of your skills 1. Personal and interpersonal skills 2. Skills used in leisure and work activities a. what could go wrong b. what skills you need to avoid mistakes c. stamp collecting d. planting a garden E. A professional finish 1. Typing 2. Paper	ILS Survivial Skills-Finding a Job-Resumes PREPARATION AND MATERIALS Large pad of newsprint and sufficient markers for group. Ensure that there are adequate flat surfaces.

F. Cover letter 1. Why them? 2. Why you? 3. Let's meet G. Self Assessment 1. Personal and interpersonal skills	HELPING WITH ASSIGNMENTS Be available throughout, when students are working on Self and Post Assessment. Write on chalkboard further suggestions of personal and interpersonal skills.
2. In a job context	Suggest students help each other in finding relevant examples of their application of skills.
3. Analyze three examples of work	Allow partners to choose each other. Emphasize broad definition of work to include paid and unpaid, part-time, etc. Give examples. Model how students can help each other. Go around and ask questions to elicit relevant information.
H. Post Assessment 1. Organizing personal work experience	Supply sheets of newsprint and markers. Tell students to use the full area of paper. Check that students are recording all the suggested information. Inspect sheets individually and suggest best way to organize data. Advise on where to include or omit dates and which experience to group or

2. Writing a draft resume	separate. Give encouragement and direct help with drafting of resume. Take best draft, type it and duplicate it on quality colored paper. With permission of student, share with whole group. Encourage sharing of draft resumes. Offer to help later if individuals want to develop a finished version of resume.

3.10 Interviews A. Subjective nature of interviews 1. Content of hiring interviews 2. Interviewers' opinions 3. Interviewees' opinions B. Facts and opinions 1. Giving honest opinions 2. Interpreting facts 3. Quoting references and examples 4. Deciding what is relevant C. Employers' expectations 1. Objective measures of aptitude and achievement 2. Appropriate attitudes and work habits D. How to communicate interest and enthusiasm 1. Be genuine 2. Be informed 3. Showing enthusiasm a. non-verbally b. how to speak and what to say E. How to communicate that you will be a good worker 1. Finding examples F. How to show you are trainable 1. School and non-school G. How to show you work well with people 1. Relations with the interviewer 2. Giving examples H. How to be realistic about what you want 1. Knowledge of the work environment 2. Knowledge of the career structure 3. Answering questions about goals	ILS Survival Skills-Finding a Job-Interviews PREPARATION AND MATERIALS Read material beforehand and recall examples from own experience. Have two copies of observers' checklist for each student.

I. Appearance
  1. Clothes
  2. Grooming

J. Non-verbal behavior
  1. Punctuality
  2. Nervousness
  3. Body posture
  4. Gestures
  5. Smoking and chewing

K. Being positive
  1. About yourself
  2. About others

L. Self Assessment
  1. Role play
    a. interviewer
    b. interviewee
    c. observer
  2. List of questions
  3. Checklist

M. Post Assessment
  1. Interview in front of the group
  2. Questions from Joint Apprenticeship Committee
  3. Giving positive feedback

FORM TRIADS

Go through checklist to ensure understanding. Choose best working groups. Keep it moving by limiting time for each role play. Be willing to model positive answers in interviewee's role.

Ask for a volunteer, then allow him or her to select next interviewee. Suggest use of observer's checklist, plus any other positive comments. Give feedback from group and yourself immediately after each interview. Invite interviewee to share his or her feelings experienced during role play.

3.11 Appropriate work habits and attitudes A. Surviving on the job. 1. Keeping informed	ILS Survival Skills-Finding a Job -Appropriate Work Habits and Attitudes BE A RESOURCE Share personal experience with individuals. Encourage students to ask any older people about work habits and attitudes. Give time for sharing students' findings.
B. Employer's expectations 1. Being punctual and dependable 2. Being honest 3. Being loyal 4. Being willing to learn and able to take criticism	Show relevance of previous modules to both 2 and 3. Ask individuals what expectations a member of Survival Skills class has.
C. Expectations of fellow workers 1. Proving your competence 2. Being reliable and dependable 3. Being a learner 4. Being enthusiastic and interested 5. Being honest and loyal	POSSIBLE DISCUSSION What do individuals expect of friends? What are peer group's attitudes toward 4?
D. Proving your competence to your supervisor 1. High standard of work 2. Keeping a written record of your achievements 3. Showing initiative 4. Taking on responsibility 5. Asking for help	
E. Interference of personal habits 1. Substance abuse 2. Seeking help	Be sensitive to possibility of substance abuse affecting student performance. Learn physical indicators; have referral addresses available.

F. Self Assessment

G. Post Assessment

Check comprehension.
Tell students to repeat reading and doing Post Assessment until acceptable standard is reached. Discuss with individuals any disagreements over appropriate answers and be flexible.

SUGGESTED READINGS:

Alberti, R.E. and Emmons, M.
Your Perfect Right
Impact, 1974.

Blicq, Ron
On the Move: Communication for Employees
Prentice-Hall, 1976

Bolles, Richard N.
The Three Boxes of Life
Ten Speed Press, 1978

Fast, Julius
Body Language
Pocket Books, 1971

Chapman, Elwood N.
Your Attitude is Showing: A Primer on Human Relations
Science Research Associates, 1972

Ford, George A.
Planning your Future: A workbook for Personal Goal Setting
University Associates, 1976

McCay, James T.
The Management of Time
Prentice-Hall, 1977

Nelson, Robert E.
Decision Making
Vision Publishing, 1976

Peale, Norman V.
The Power of Positive Thinking
Prentice-Hall, 1952.

4.0 Trade Math

INSTRUCTIONAL OUTCOMES: The student will complete a diagnostic examination to determine his or her level of math competency, and will receive instruction in those areas of mathematics in which he or she experiences difficulty.

INTRODUCTION: People in every apprenticeable occupation routinely use mathematics in their work. The skilled worker who can perform fast and accurate math calculations can work quickly and efficiently.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
4.1 Math Diagnosis A. Used to test skills 1. Math diagnostic exam, attached, or other suitable exam.	Explain "placement exam" concept Administer exam Grade performance
4.2 Math Remedial A. Used to upgrade skills 1. Modules, as listed, improve performance levels.	Assist student to achieve performance level

ILS	Math--Linear Measurement	
ILS	Math--Whole Numbers Addition Subtraction Multiplication Division	
ILS	Math--Addition & Subtraction of common fractions and mixed numbers	
ILS	Math--Multiplication & Division of common fractions and whole and mixed numbers	
ILS	Math--Compound numbers	
ILS	Math--Percent	
ILS	Math--Ratio and Proportion	
ILS	Math--Decimals Addition Subtraction Multiplication Division	
ILS	Math--Perimeters Areas and Volumes	
ILS	Math--Circumference and Area of Circles	
ILS	Math--Areas of Plane Figures, Volumes of Solid Figures	
ILS	Math--Metrics	

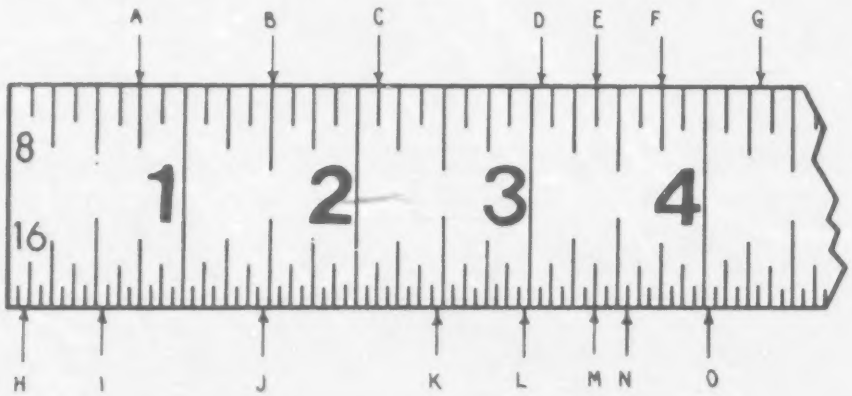
4.0 Trade Math Diagnosis
Placement Test

Name _____

Date _____

1.

Read the distance from the start of the ruler to the letters A through O to the nearest 1/32".



A=_____ F=_____ K=_____

B=_____ G=_____ L=_____

C=_____ H=_____ M=_____

D=_____ I=_____ N=_____

E=_____ J=_____ O=_____

2.

686 + 240 + 1,320 + 16 + 400 =

40 - 16 =

292 X 16 =

180 ÷ 5 =

A contractor buys 400 sacks of rock for three different jobs. On the first job he uses 78 sacks; on the second, 85 sacks; and on the third, 205 sacks. How many sacks does he have left?

A contractor's bid on a school building is $78,265. When one wing is omitted to cut costs, he is able to cut his bid by $16,228. What is his new figure?

3.

If a bundle of rock lath weighs 35 lbs. and it is permissible to place 700 lbs. on any one area on a floor, how many bundles can be placed on any one area?

If 5 lbs. of putty are required to install one light of glass, how many lights can be installed with 85 lbs.?

4.

The improper fraction 48/32 expressed as a mixed number is:

The mixed number 4 3/8 expressed as an improper fraction is:

What is the least common denominator for the following group of fractions: 1/8, 1/2, 1/4, and 1/12?

What is the sum of the following fractions: 7/8, 3/4, and 9/16?

If 3/4 is subtracted from 11/12, the difference is:

The sum of 1 5/8, 2 11/64, and 19 1/4 is:

5.

One roof is 1/3 larger in area than another. The smaller roof takes 24 squares of roofing material. How many squares of roofing material will the larger roof take?

One-third of a box of glass is needed to glaze the north elevation of a building; 2/3 of a box is needed to glaze the south elevation; 1/16 of a box is needed to glaze the east elevation; and 1/2 of a box is needed to glaze the west elevation. How many boxes are needed to glaze all four elevations?

From a bundle containing 101 linear feet of molding, a cabinetmaker uses the following amounts: 11 1/3', 8 3/4', 12 1/8', and 9 5/8'. How many linear feet of molding does he use in all?

6.

The product of 1/2 X 7/8 is:

The quotient of 1/4 ÷ 1/3 is:

If a roll of carpet weighs 467 1/2 lbs. and a running foot of the carpet weighs 2 1/8 lbs., how many running feet are in the roll?

A piece of pipe must be cut to 3/8 the length of another pipe, which is 9' long. How long a piece must be cut?

7.

Write each of the following as decimals.

Seven tenths

Sixteen hundredths

Fifteen thousandths

Eleven ten-thousandths

Two thousand one hundred fifty-two thousandths

Convert each of the following measurements to feet in decimals.

4' 6"

2' 4 1/4"

A house with a floor area of 1,860 sq. ft. is estimated to cost $18,042. What is the cost per square foot?

A stack of plastic sheets measures 2.28" thick, and it is known that the sheets average 0.06" in thickness. How many sheets are in the stack?

8.

The labor cost for the concrete work for a house was $248. The material cost $210. What percent of the total cost of the concrete work was for material?

An architect indicates a 1/8" = 1'0" scale in the drawing of a swimming pool. What is this scale expressed as a ratio?

On a tile job in which fireclay is to be used, a tilesetter tells his helper to mix mortar according to the following formula: 6 buckets of river sand, 1 bucket of fireclay, and 2 buckets of cement. What is the ratio of sand to fireclay in the mixture?

9.

Divide 19' 2" by 3' 10".

How many pieces of 2' 3"-wide gypsum lath will be needed to cover a wall 48' 6" long?

10.

What is the perimeter of a room 20' wide and 30' long?

What is the area, in square feet, of a floor 42' by 42'?

How many cubic yards of dirt have been removed for the basement and foundations of a house if the excavation is 35' long, 35' wide, and averages 5' deep?

The area of a circular putting green with a radius of 17' is how many square feet?

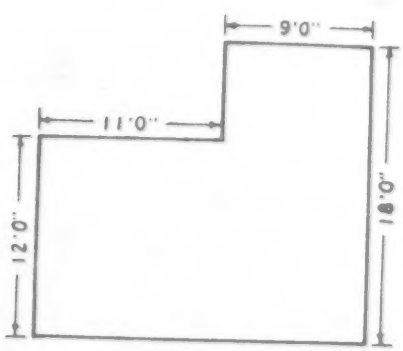
What is the area of a circular floor with a diameter of 10' 6", to the nearest square foot?

What is the area, in square inches, of an acute triangle with a base of 8 1/2' and an altitude of 11 1/4"?

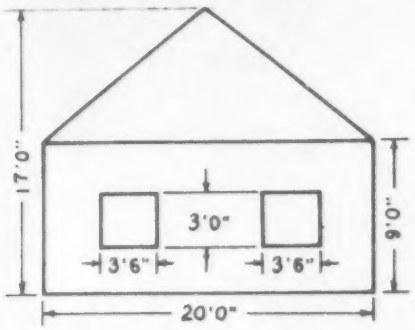
What is the area in square feet, of the floor shown below?

How many cubic yards of concrete will be needed for the foundation walls and footings in the plan below if the walls are 6" thick and 18" deep, and if the footings (shown in dotted lines) will require 2 5/27 cu. yd. of concrete?

1. 6
2. 6 2/3
3. 7
4. 7 1/6



What is the total area, in square feet, of the exterior wall and gable shown below, excluding window areas?



11. Metrics

3 inches	=	cm
5.4 inches	=	cm
7 feet	=	m
3.2 feet	=	m
6.5 yards	=	m
15.3 m	=	inches
12.7 cm	=	inches
50.8 mm	=	inches

5.0 Physical Requirements/Automotive Mechanic

INSTRUCTIONAL OUTCOMES: The student will demonstrate knowledge of physical requirements of the trade and the processes of physical development.

INTRODUCTION: The trade requires certain physical skills and abilities of the worker. It is necessary that the student be aware of the physical demands of the trade and understand factors of physical development.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
5.1 Physical Requirements A. Strength 1. Lifting. a. parts and equipment weighing 20 to 125 lbs. (e.g. batteries and generators/alternators). 2. Carrying. a. parts and equipment weighing 20 to 50 lbs. 3. Pushing. a. loosening nuts and bolts. 4. Pulling. a. tightening nuts and bolts to proper torque.	On-site visit or classroom simulation. A. Demonstrate B. Lead discussion or question on job site C. Discuss proper technique D. Administer work sheet

B. Body Dexterity
   1. Stooping.
      a. working over fenders.
   2. Kneeling.
      a. looking under cars off rack.
   3. Crouching.
      a. checking tire pressure/wear condition.
   4. Standing.
      a. operating scope analyzer.
   5. Reclining.
      a. laying on creeper under vehicle.

C. Manual Dexterity
   1. Reaching above shoulder.
      a. working on vehicle on lift (e.g. draining oil).
   2. Reaching below shoulder.
      a. working on engine (e.g. removing spark plugs).
   3. Handling.
      a. gripping tools and equipment.
   4. Fingering.
      a. grasping and starting nuts and bolts.
   5. Feeling.
      a. checking for wear/alignment (e.g. bearings).

D. Talking
   1. Normal communication

E. Hearing
   1. Normal communication.
   2. Detection of sound variations (e.g. universal joint vs. transmission).

F. Vision

1. Normal vision.
   a. moving about shop.
2. Acuity near.
   a. removing, replacing and adjusting small parts.
3. Depth perception.
   a. reaching for parts on operating engine.
4. Color vision.
   a. color coded connections.

G. Coordination

1. Hand-arm.
   a. using tools and equipment (e.g. torque wrench).
2. Foot-leg.
   a. adjusting hoisting clutch.
3. Eye-hand-foot.
   a. test driving vehicles.

PHYSICAL ACTIVITIES PRESENT IN THE TRADE: REQUIREMENTS (to be completed by student)

STRENGTH	Weight	Frequency	BODY DEXTERITY	Degree of Activ.	Frequency	MANUAL DEXTERITY	Degree of Activ.	Frequency
Lifting			Stooping			Reaching-above shoulder		
Carrying			Kneeling			Reaching-below shoulder		
Pushing			Crouching			Handling		
Pulling			Crawling			Fingering		
BALANCE	Need	Frequency	Standing			Feeling		
Climbing			Sitting			TALKING (speech)		Frequency
Balancing			Walking			HEARING	Acuity	Range
VISION	Need	Frequency	Reclining			COORDINATION	Degree	Frequency
Normal vision			VISION (Cont'd)			Hand-arm		
Acuity-near			Color vision			Foot-leg		
Acuity-far			Field of vision			Eye-Hand-Foot		
Depth perception								

5.2 Individual Developmental Processes A. Maturation 1. Causes physical changes in height and body proportion. 2. Causes emotional changes. 3. A gradual process. 4. Fluctuates from person to person. B. Nutrition 1. Vital to normal growth and development. 2. Essential food groups. a. dairy products. b. meat. c. vegetables and fruits. d. bread and cereals. C. Personal Care and Exercise 1. Good grooming habits. 2. Sufficient sleep and relaxation. a. fatigue increases chances for accidents. 3. Hobbies. a. source of relaxation, help to maintain good attitude. 4. Daily exercise. a. stimulates interest. b. relieves stress. D. Substance Abuse 1. Marijuana. a. affects nervous system. b. affects thinking, judgment and coordination. c. long-term effects unknown.	ILS Physical Development Explanation and Discussion Invite Specialist

2. LSD. a. affects chemical level in brain. b. produces bizarre mental reactions. 3. Barbiturates. a. one of most commonly abused drugs. b. slow responses. c. physically addicting. d. long-term use causes personality disorders. 4. Amphetamines. a. affect central nervous system. b. commonly abused. c. cause psychological dependence. d. dull emotions and impair ability to make decisions. 5. Alcohol. a. psychologically addicting.	
E. Meeting Various Trade Requirements 1. Recognize and prepare. a. natural maturation processes may play role. b. exercise will play role.	On-job-site visitations and consultation with occupational therapist.

9.0 Automotive Systems/Components

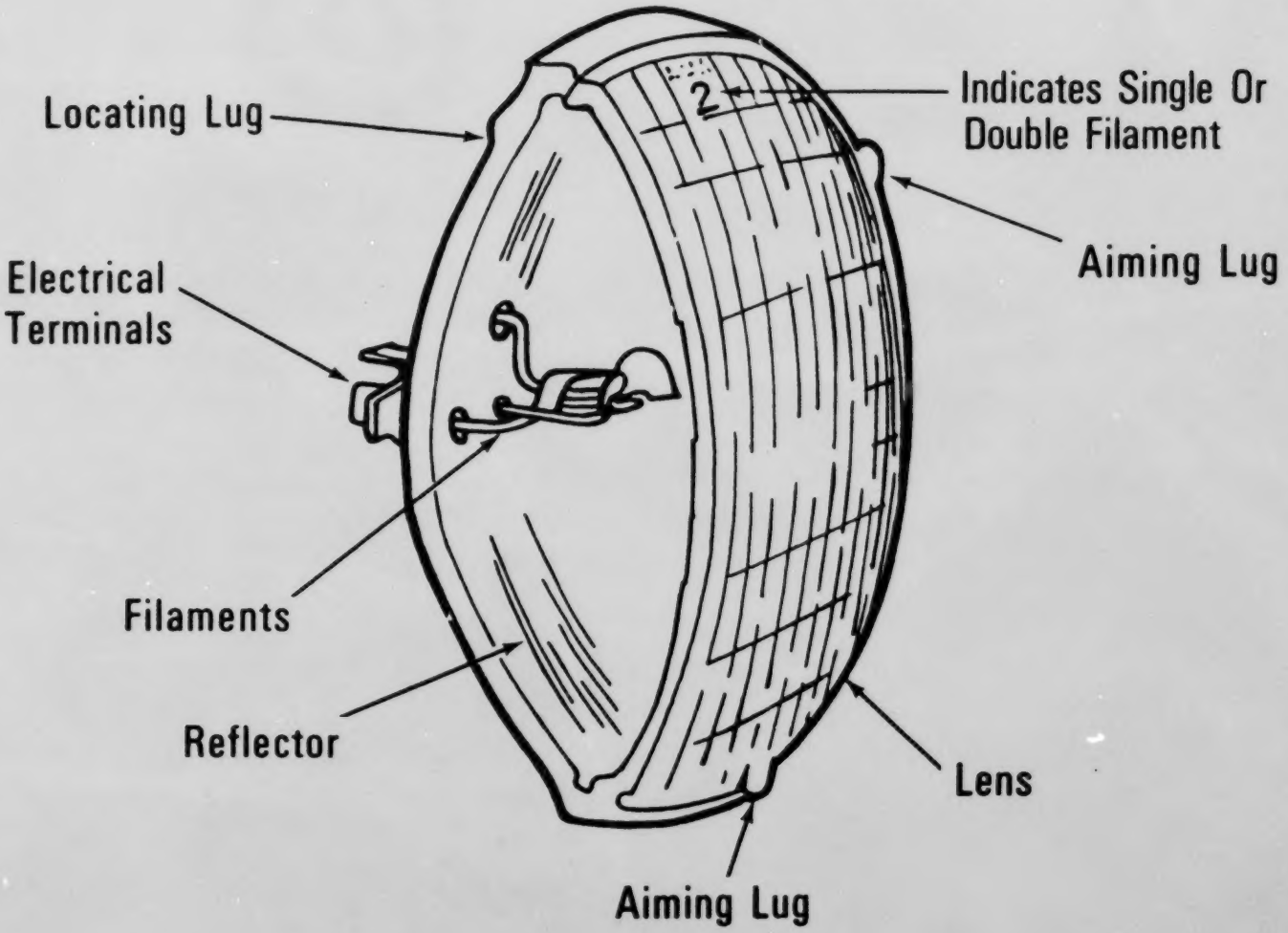
INSTRUCTIONAL OUTCOMES: The student will be able to identify and explain the purpose of basic automotive systems (and components of systems).

INTRODUCTION: It is essential that the skilled worker understands the various components which make up a complete automotive system.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
9.1 Electrical Components A. Headlights (Sealed Beam) 1. Round--5 3/4" to 7" diameter, no. 1 and no. 2. 2. Lights with filaments, lens and reflector manufactured in one unit; vacuum sealed, repairs are not possible. 3. If sealed beam fails, must be replaced. Round seal beams are frequently numbered on top of glass lens and should be replaced with corresponding correct number. A number 1 & 2 are used on each side of a vehicle using 4 seal beams.	Explain, Discuss and Demonstrate Where Appropriate Overhead Master--Sealed Beam Lamp ILS 7005, 7004, 7003, 7006 7007, 7008, 7009, 7010

Sealed Beam Lamp



4. Rectangular seal beams have been used on vehicles since 1976 and vehicles may need one or two pairs.
5. Due to different shapes and purposes, interchanging should not be attempted.

B. Bulbs

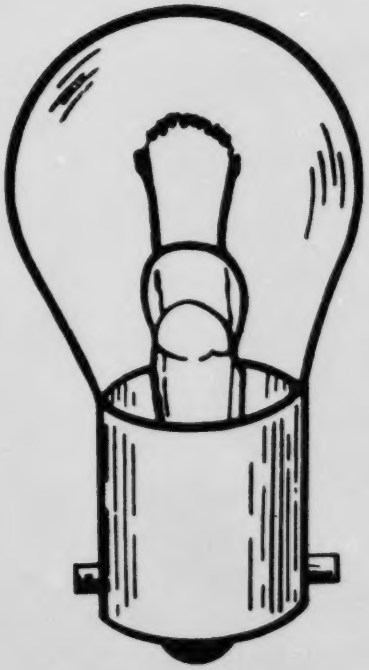
1. Cars have other lights that use bulbs.
2. Numbered on the brass base and because of differences in size and power, no attempt should be made to interchange.
3. When a bulb burns out or fails the lens cover can be removed and a bulb of corresponding number installed.

Overhead Master--Bulb

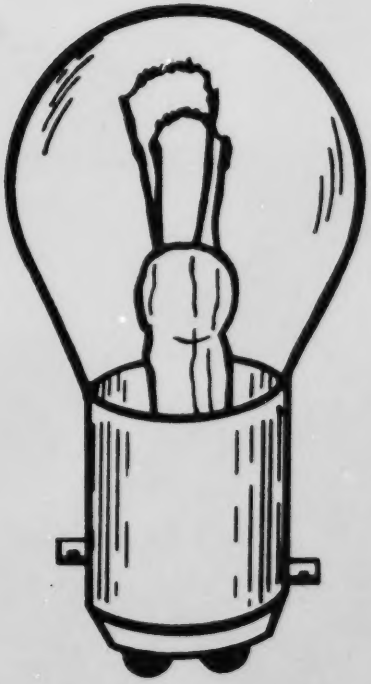
C. Fuses

1. Contains a soft metal strip connected at the ends to fuse caps. If excessive current flows through the fuse, the metal strip overheats, melts or "blows," opening the circuit and protecting electrical devices.
2. Installed in electrical circuits to protect the electrical devices in the circuits. Their purpose is to open the circuit in case a short or ground developes and dangerously high currents start to flow. If this occurs, the fuse "blows" or burns out.
3. Cause of a blown fuse should be checked and corrected before it is replaced.

Bulb



SINGLE-FILAMENT BULB



DOUBLE-FILAMENT BULB

D. Circuit Breakers

1. Contains small winding that carries current in circuit.
2. When current flow is too high, winding mechanism opens points to open circuit. Advantage is that it keeps resetting itself.

E. Fusible Links

1. Typical fusible link is a wire inserted in larger high-current carrying wires. The link itself is simply a wire several gauges smaller than the wire it is protecting.
2. If short or ground occurs, fusible link will burn in half before larger wire, protecting other parts of circuit.

F. Printed Circuits

1. A flat piece of insulating material on which a series of conduction strips are printed.
2. Found in instrument panels and control systems in electrical system.

G. Flasher Units

1. Small device that contains small coil and switch.
2. Found mostly in turn signal lights and hazard warning lights.
3. Heating and cooling of small coil causes switch to rapidly heat and cool and alternately open and close electrical circuit.

H. Stoplight Switch

1. Operates the lights at the rear of the car.
2. In older cars the switch was connected to the hydraulic system. Fluid pressure operated the switch. Switch used on cars today is a mechanical switch operated by the brake pedal.
3. When brakes are applied, switch contacts close and lights come on.

I. Battery

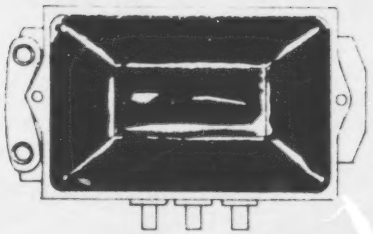
1. Supplies current to operate starter and ignition system when the engine is being started.
2. Chemicals in battery produce electrical energy. (Interaction of chemicals, sponge lead, lead oxide, and sulphuric acid produce electrical current required).
3. Battery construction provides that each cell produces two volts. Six-volt batteries have three cells, more widely used 12-bolt has 6 cells.
4. Battery cables
   a. Batteries are connected to car's electrical system by heavy cables. Positive (or plus) cable directs current into electrical system; negative cable (or ground) returns, completes circuit to battery.

Overhead Master--Charging System Components

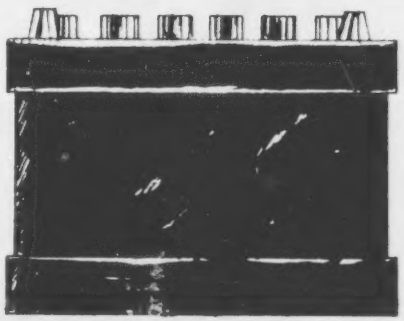
Charging System Components

Ammeter

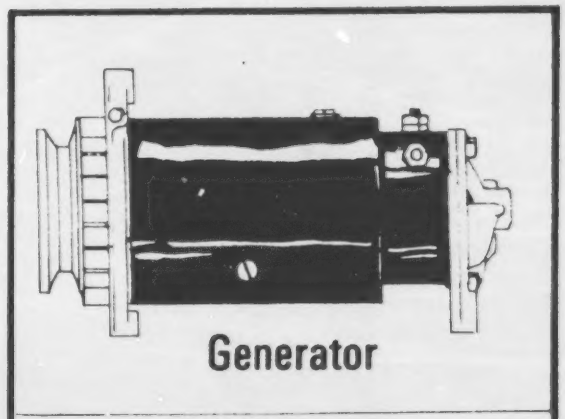
(NOTE: Indicator light replaces ammeter on some models.)



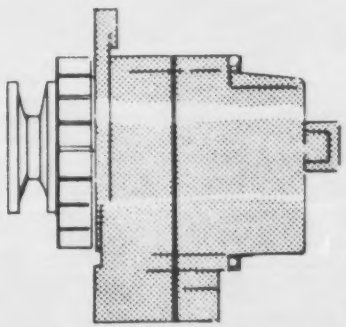
Regulator



Battery



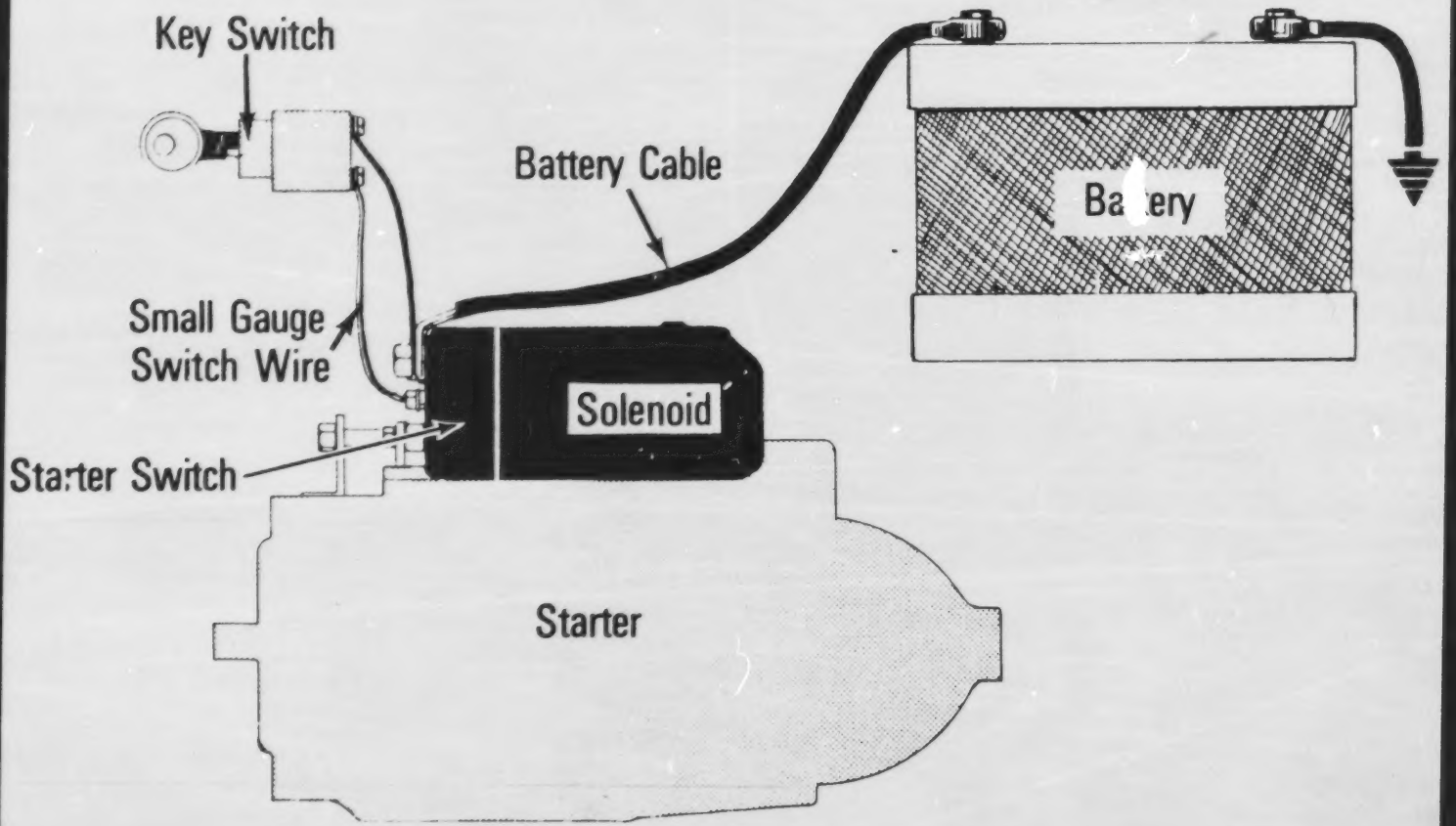
Generator



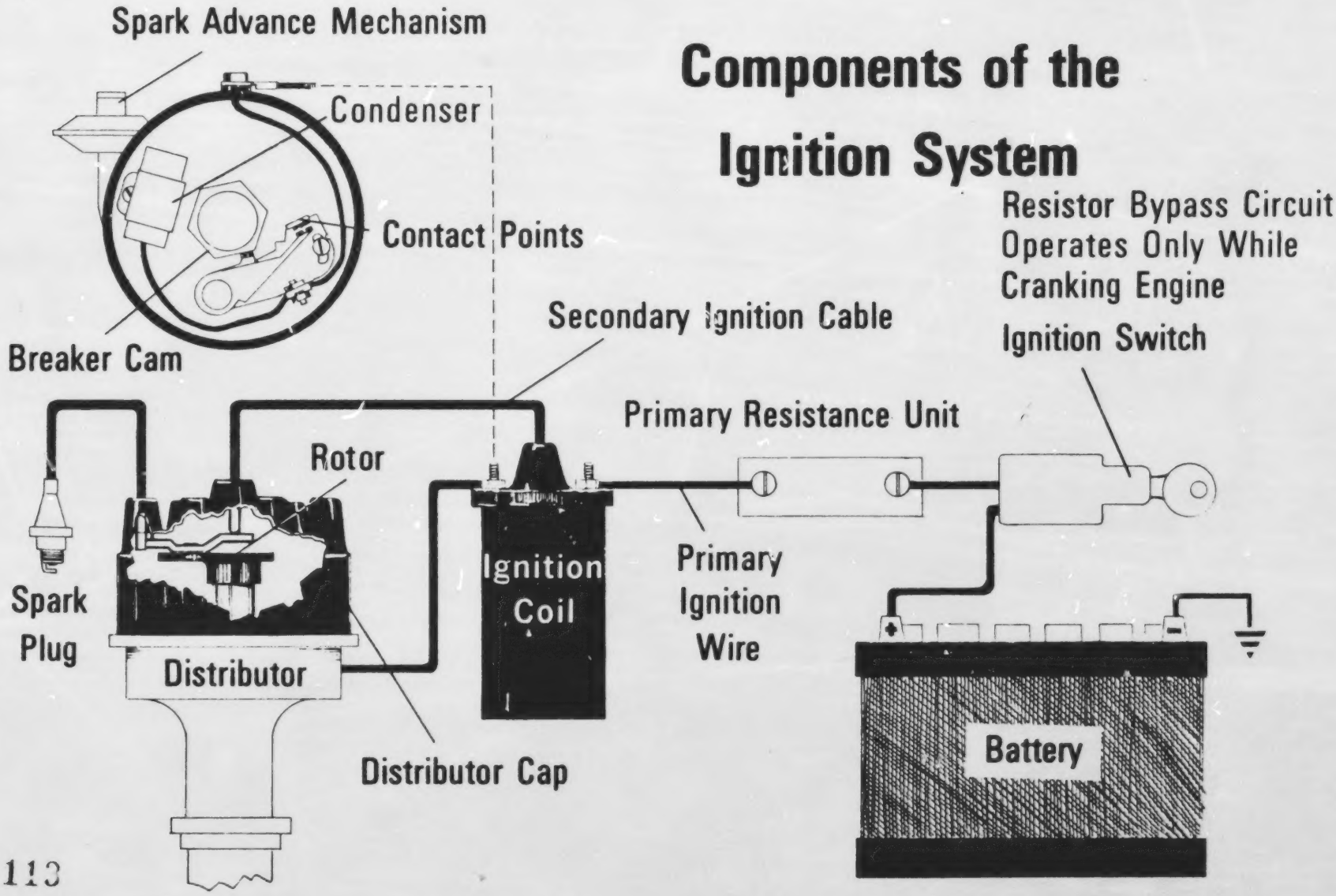
Alternator

J. Starter Motors 1. A high-capacity, sturdy, electric motor, designed to provide high-power required to spin engine crankshaft and get engine started. 2. When starter is connected to battery, a gear drive is meshed with a gear on the flywheel and starter motor turns, thereby turning flywheel and rotating the crankshaft. K. Generator/Alternator 1. Provides electrical current to run vehicle's electrical systems as long as the engine is running, also to replenish battery. 2. Turned by a belt on engine, driven by a series of pulleys, generator/ alternator produces voltage. L. Regulators 1. Necessary to control amount of voltage output to avoid overcharging.	Overhead Master--Components of the Charging System
9.2 Ignition Systems A. Distributor (ignition points, condenser - capacitor, distributor cap, rotor) 1. Two types of ignition distributors: type with contact points and electronic type.	ILS 7003-7010 Overhead Master--Components of the Ignition System

Components Of The Starting System



Components of the Ignition System



2. Typical ignition system consists of battery (source of power), ignition switch, ignition coil, distributor, spark plugs and wiring.
3. Condenser - capacitor--functions when contact points begin to separate. (Current continues to flow even after distributor contacts start to separate.) Condenser prevents current from jumping across separating contact points, creating arc, which would waste most of voltage surge, also "burning" points.
4. Distributor cap--plastic cap which covers rotor, condenser points and other components for assembly of the distributor. There are contact points in the cap which correspond to the number of spark plugs and the firing order of the engine.
5. Rotor--a rotary switch located on top of cam in the distributor. As distributor shaft rotates, cam and rotor also rotate.
   a. purpose of rotor is to connect center terminal of distributor cap to outside terminals of distributor cap.

B. Spark Plugs
   1. Contains an insulator to hold the center electrode, a shell to support insulator, and a ground electrode.

2. When high-voltage surge enters spark plug, it flows down center electrode and jumps from lower end of center electrode to ground electrode.
3. Some spark plugs have resistor built in; reduces current flow through spark plug, helping reduce interference on radio and television receivers.

C. Spark Plug Wires
1. Made of special string coated with carbon.
2. Identified by size (normal wires are 7mm in diameter).
3. Heavy insulation to hold in power surges.

D. Ignition Coil
1. Contains a high-voltage terminal, primary terminals, coil cap., laminations, secondary winding, primary winding, coil case, glass insulation.
2. When contact points in distributor close, they connect primary winding to battery. Magnetic lines of force build up almost instantly around primary winding; when magnetic field is built up, contact points open as soon as current flow stops; magnetic field collapses rapidly, producing high voltage surge in secondary winding.

9.3 Fuel Systems (fuel tank, fuel filter, fuel pump, carburetor, intake manifold, fuel lines)

A. Fuel Tank

1. normally located at the rear of car; made of plastic or sheet metal; has two main openings, gas enters through one, leaves through another. (Cars manufactured after 1970 have added system that prevents escape of gasoline vapors from fuel tank; system sends vapors to charcoal canister).

B. Fuel Filter

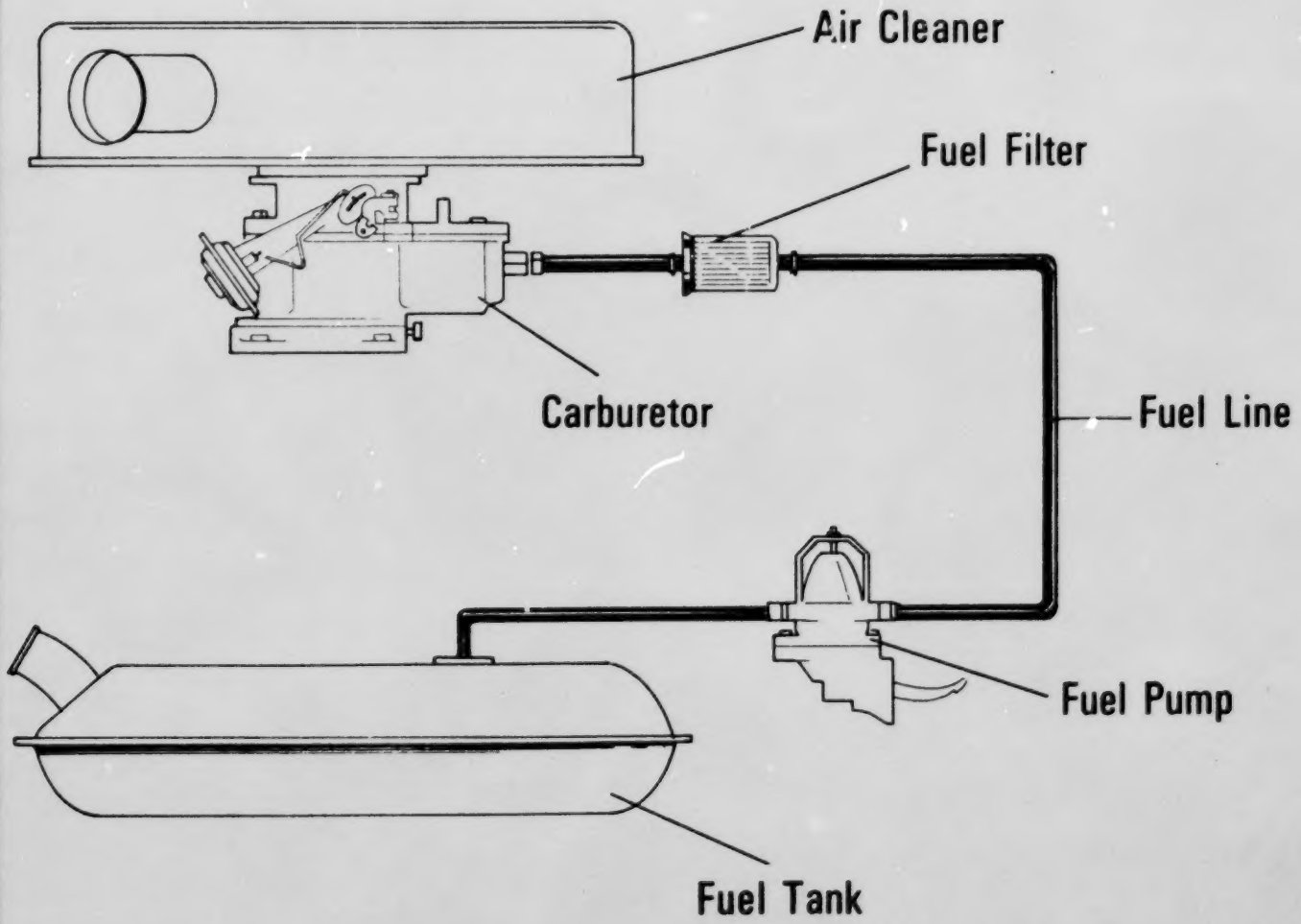
1. Made of special paper or other material that lets gasoline through and traps water and dirt.

C. Fuel Pump

1. Mounted on the engine.
2. Function is to draw gasoline from tank to carburetor.
3. Accomplished by rotation of camshaft, draws diaphragm up and down, producing a vacuum. When diaphragm is pulled up, partial vacuum created opens the inlet valve; gas flows from fuel tank through inlet valve into gasoline chamber; spring pressure pushes inlet valve closed and pushes outlet valve open; pressure forces gasoline out of gasoline chamber through fuel line to carburetor.

Overhead Master--Components of the Fuel System

Components of the Fuel System



D. Carburetor (Types)

1. Two basic types, fixed-venturi and variable. (Venturi is the restricted place in a passage through which air must flow; restriction produces a partial vacuum which causes fuel nozzle to discharge gasoline; gasoline mixes with the air to produce combustible; passes through intake manifold to engine cylinders where it is compressed and burned.
2. Basically comprised of a float system, idle system, main metering system, power system, accelerator pump and choke.

E. Intake Manifold

1. On V-6 and V-8 engine, sits between two banks of cylinders, carburetor sits on top of intake manifold.
2. Has several passages through which the air-fuel mixture flows from the carburetor to the parts in the cylinder head or cylinder block
3. Manifold has same number of passages from carburetor to cylinders as there are cylinders.

F. Fuel Lines

1. The pipes or tubes through which fuel flows.
2. Functions by carrying fuel from gas tank to filter to fuel pump to carburetor.

9.4 Cooling System

A. Water Jackets

1. Located around engine cylinders; cast into cylinder blocks and heads.
2. Water circulates through jackets, to carry heat away.

B. Water Pumps

1. Mounted near front of cylinder block, between block and radiator.
2. Consists of a housing, water inlet and outlet, and an impeller; impeller is a flat plate mounted on a shaft with a series of curved blades or vanes.
3. As impeller is rotated, coolant is drawn from bottom of the radiator into pump inlet and cylinder block, through pump outlet. Pump is driven by a V-belt from the crankshaft; centrifugally operated.

C. Fan Belts

1. V-type.
2. Friction between sides of belts grooves in pulleys causes driving power to be transmitted through belt from one pulley to another.

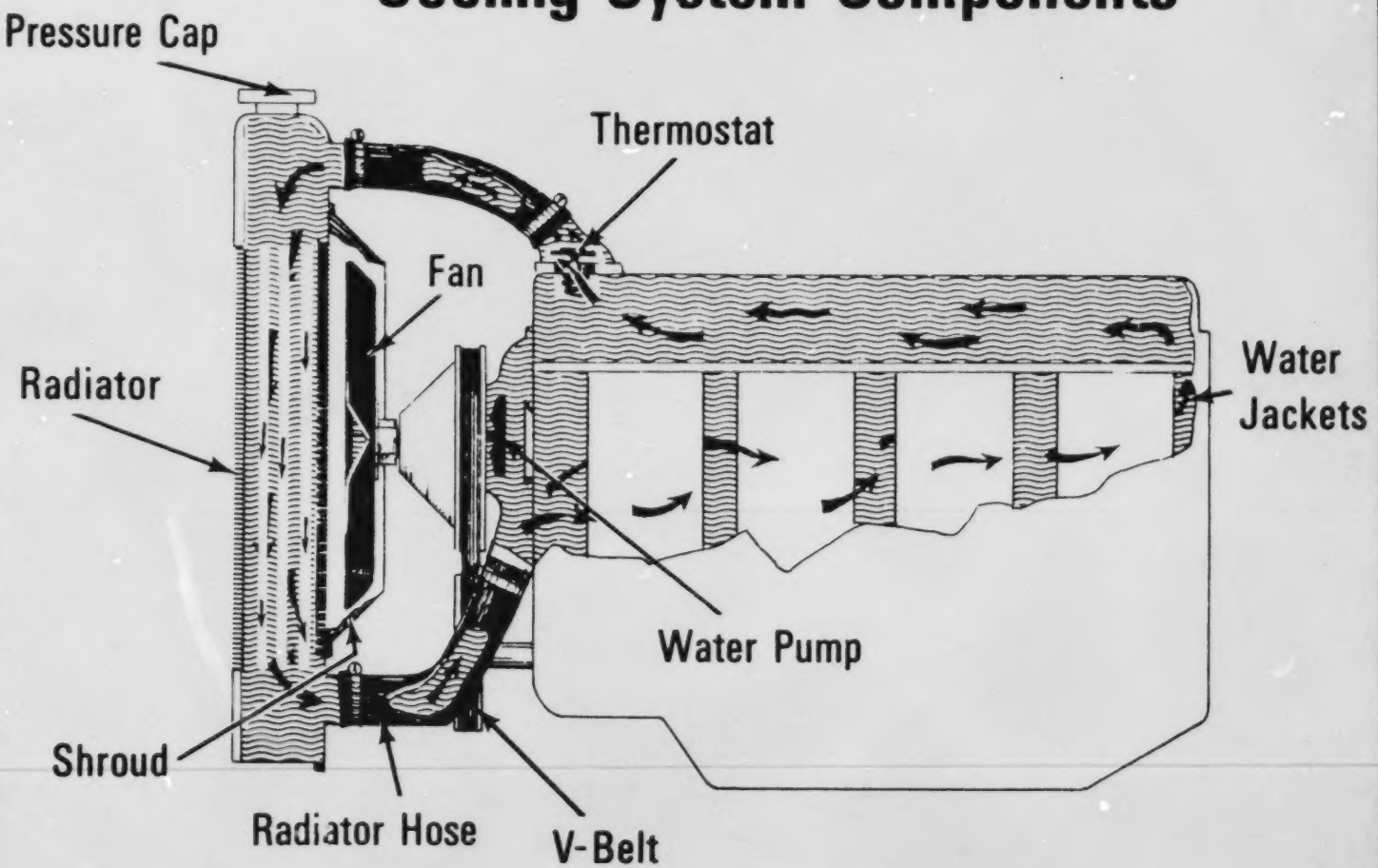
D. Fan

1. Usually mounted on water pump shaft in close proximity to radiator.
2. Insures a strong draft of air through radiator and over engine to aid in cooling.

Overhead Master--Cooling System Components

VIP 109-B, 61-304-A Engine Cooling System

Cooling System Components



E. Radiator

1. A device for holding a large volume of coolant in close contact with a large volume of air.
2. Two common types of radiators used in automobiles; tube and fin and ribbon-cellular.
3. Radiator core is divided into two sparate and intricate compartments. Coolant passes through one, and air passes through the other. Reservoirs are located at top and bottom of core for additional storage.
4. Connected to engine by hoses.

F. Hoses

1. Usually made of a rubber composition with fabric core; some equipped with coil spring wire inside to prevent collapse of hoses due to surging of coolant.
2. Connect various parts of cooling system together.

G. Thermostat.

1. Located in a coolant passage between cylinder head and top of radiator.
2. Purpose is to control flow of engine coolant, allow engine to warm up quickly by restricting flow when cylinder block is cold and allowing unrestricted flow when engine is at normal temperature.
3. Valve fluctuates to maintain engine at most efficient temperature.

H. Pressure Cap

1. Fits over radiator filler tube and seals tightly around edges; contains tow valves, blowoff valve and vacuum valve.
2. Used for increasing air pressure within cooling system several pounds PSI so water may be circulated at higher temperatures without boiling.
3. Vacuum valve prevents formation of a vacuum in cooling system when engine is down and begins to cool.
4. Blowoff valve raises from seat, allowing pressure to escape, if exceeds system limitations.

I. Antifreeze Solutions

1. Most commonly used antifreeze solution is one-half ethylene glycol, and one-half water.
2. Used to prevent freezing of cooling system and resulting water expansion and block cracks.
3. Also helps to prevent leaks and corrosion.
4. Recommended by car manufacturers that radiator be drained and flushed once a year.

J. Temperature Indicators

1. Indicator light system has a "coolant temperature sending unit" mounted on the engine, exposed to cooling system coolant.
2. Sending unit is connected to two light bulbs and battery through ignition switch.

3. When ignition is first turned on, sending unit thermostatic blade is in proper position to connect the cold light to battery. It comes on. (The cold light, which appears in blue, on the instrument panel, remains on until engine approaches operating temperature. As this happens, thermostatic blade in the sending unit is bent by increasing temperature; blade therefore moves off the cold terminal disconnecting the cold light so that it turns off.)
4. (Some indicator-light systems do not have a cold light instead, hot light comes on during starting and goes off when engine starts; stays off unless engine overheats.

9.5 Oils and Greases

A. Oil

1. Used for reducing wear and friction between moving parts at surfaces; to lubricate parts to minimize power loss from friction; to remove heat from engine parts by acting as cooling agent; to absorb shocks between bearings and other engine parts; to reduce engine noise and to extend engine life; forms good seal between piston rings and cylinder wall and acts as cleaning agent.

2. Many additives such as viscosity index, oxidation inhibitors, corrosion inhibitors, rust inhibitors, foam inhibitors, detergent dispersants, extreme-pressure agents.
3. Manufacturers specify type of oil for engine and recommend time spans for change.
4. Oil viscosity refers to the ability of a liquid to flow; high viscosity is very thick and flows slowly, low viscosity flows easily.
   a. rated in two ways by Society of Automotive Engineers, (S.A.E.), winter driving and summer driving. Winter grade oils come in three grades SAE 5 W, SAE 10 W, and SAE 20 W. "W" means winter grade.
   b. other grades are SAE 20, SAE 30, SAE 40, and SAE 50; higher the number the higher the viscosity.
   c. many oils have multiple-viscosity ratings, e.g. SAE 10 W-30 has same visocisity as SAE 10 W when cold and same viscosity as SAE 30 when hot.
   d. service rating indicates type of service for which oil is best suited for gasoline engines.
      (1) SA--acceptable for engines operated under midwest conditions.
      (2) SB--acceptable for minimum duty engines operated under mild conditions.

(3) SC--meets requirements of gasoline engines, 1964 to 1967 model passenger cars and trucks.

(4) SD--for 1968 to 1970 models.

(5) SE--1972 and certain 1971 cars and trucks.

(6) Diesel engines require different types of oil; service rated CA, CB, CC, and CD.

B. Grease

1. Many types and kinds of grease for use in servicing and maintenance of autos.

2. A basic list most commonly used:

Symbol	
MP	RPM multi-service gear
HG	RPM HD Chassis grease
CG	RPM HD Chassis Grease
	RPM Automotive Grease
	RPM HD Chassis Grease (TB)
WB	RPM Automotive Grease
	RPM Wheel Bearing Grease
	RPM HD Chassis Grease
WP	RPM Water Pump Grease
	RPM HD Chassis Grease
	RPM Automotive Grease
GG	RPM HD Chassis Grease
	RPM Automotive Grease
	RPM Gear Grease

3. Each make has a base lubrication and grease requirement; should be followed as recommended.

4. Basic systems requiring grease are front end points, under hood points, center chassis points and rear end points.

9.6 Automotive Fluids

A. Automatic Trans. Fluid

1. Referred to as ATF; is considered form of oil.
2. Contains several additives; colored so that it can be recognized from other oil.
3. Oil and transmission fluids should not be interchanged or used for purposes that were not intended.

B. Brake Fluid

1. Not oil; a very special fluid that is little affected by high or low temperatures.
2. Will not damage or corrode metal and rubber parts, in braking system. (Ordinary oil will damage the brake system parts).
3. Only brake fluid recommended by the manufacturer and meet legal requirements should be used.

C. Dichlorodifluormethane

1. Commonly referred to as Freon or F-12, the refrigerant used in automotive airconditioning.
2. Boils at extremely low temperature and is dangerous unless handled by a skilled worker who is knowledgeable about air conditioning systems.

D. H_2SO_4

1. Electrolyte, sulphuric acid, mixed with water.
2. Used in an automotive storage battery.
3. Is a very corrosive solution that burns and etches everything it contacts; fumes are highly explosive and toxic; requires special handling, using safety precautions.

E. Power Steering Fluid

1. A special kind of oil. In some automobile applications ATF is used; in others special power steering fluid is only kind recommended.
2. Manufacturer's shop manuals should be consulted and their recommendations
3. Purpose is to lubricate as well as operate.

F. Windshield Washer Fluid

1. Fluid is superior to water in a washer system; does not freeze and damage the system, contains chemical additives that aid in cleaning the windshield of road grime and dirt.

9.7 Engine Lube System

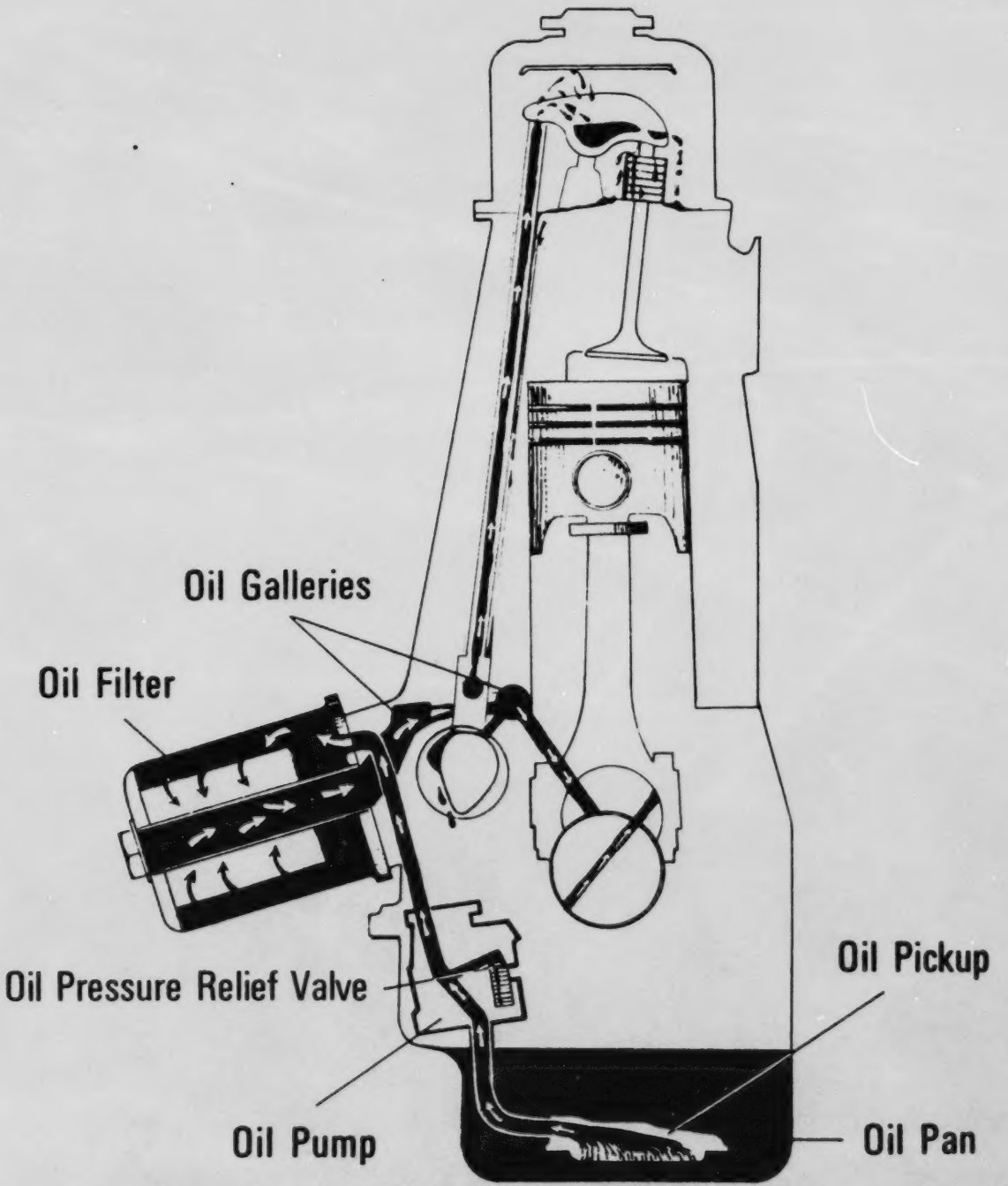
A. Pumping Systems

1. Engines are lubricated by pressure feed pump system; may parts lubricated by oil fed under pressure from oil pump into oil line to main bearings and camshaft bearings.
2. Main bearings have oil-feed holes or grooves that feed oil into drilled passages in crankshaft; the oil flows through passages to connecting-rod bearings; (on some engines) it flows through holes drilled in connecting rods to piston-pin bearings.
3. Cylinder walls are lubricated by splashing oil thrown off by connecting-rod bearings.
4. Oil is pumped through system with one of two types of oil pumps.
   a. gear type pump uses a pair of meshing gears; as gears rotate, spaces between gear teeth are filled with oil from oil inlet; as teeth mesh, the oil is forced out through outlet.
   b. rotor-type pump uses inner rotor and outer rotor; inner rotor is driven and causes outer rotor to turn; spaces between the rotor lobes are filled with oil when the lobes of inner rotor move into spaces in outer rotor; oil is squeezed out through outlet.

Overhead Master--Components of the Engine Lubrication System

VIP 57, 109-A, 108-B, 108-A
Automotive Mechanics

Components of the Engine Lubrication System



B. Oil Filters

1. Some or all oil from oil pump circulates through filter.
2. Contains cartridge of filtering material that traps particles of foreign matter; helps to keep oil clean and prevent particles from entering engine.
3. Two types, one which filters part of bypass filters; one which filters part of oil from oil pump is bypass filters; one which filters all oil in circulation through system is full-flow filter.
4. Flow filter includes spring-loaded bypass valve which protects engine against oil starvation if filter becomes clogged; valve opens by increased pressure from pump trying to push oil through; with valve opened, oil bypasses filter; filter element should be replaced to maintain efficiency.

C. Oil Indicator Light

1. Comes on when engine fist is turned over and oil pressure is low; after engine has warmed up oil indicator light goes off; if it remains on, engine and lubricating system should be checked at once to find cause of low pressure.

2. Light is connected to pressure switch in engine; switch is closed until oil pressure increases to normal values.
3. Indicator light and pressure switch are connected in series to battery, through ignition switch; when ignition switch is turned on, indicator light comes on; stays on until oil pressure increases enough to open pressure switch.

D. Oil Level Indicator
1. Used to determine level of oil in oil pan.
2. Oil level stick, or dipstick is used; protrudes into oil; level determined by withdrawing dipstick and noting level. (In closed or positive crankcase ventilating system (PCV), dipstick tube is sealed at top when dipstick is in place; keeps unfiltered air from entering crankcase, and crankcase gasses from escaping.)

SUGGESTED READING

1. Notgrass, Troy
Auto Parts Counter Worker

University of Texas, Austin, 1979

2. Micheels, W. J.
A Workers Introduction to Wholesaling in the Automotive Industry

National Standard Parts Assoc., 1952

3. A.S.T.A.
Counterman's Handbook

Automotive Service Industry Assoc., 1963

10.0 Applied Auto Mechanics Concepts

INSTRUCTIONAL OUTCOMES: Student will demonstrate and execute basic trade skills by completing a project to the satisfaction of the instructor.

INTRODUCTION: This instructional unit provides students an opportunity to practice techniques followed in the Pacific Northwest; appropriate techniques will have been learned in previous topics in this guide.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
10.1 Antifreeqe Testing A. Start engine and allow time for coolant to warm up to operating temperature. B. Remove radiator cap. 1. Never remove the radiator cap quickly when the engine is hot. Loosen cap slowly to first stop and leave in this position until all pressure is released. Cap can then be removed safely. C. Draw coolant into tester and empty several times to equalize the temperature of all parts.	Explain and Discuss Administer Project Sheet

D. Draw coolant into tester.

E. Read the first number or letter on the float above the liquid surface.

F. Note temperature of coolant.

G. Measure antifreeze content of the water by comparing the readings with the chart on the tester. (Note: The antifreeze content should be such that the cooling system would be protected to $10^{o}F$ ($5^{o}C$) lower than the coldest temperature expected.

H. Add antifreeze if necessary.
   1. Allow room for expansion.

10.2 Battery Service: Removal and Replacement

A. Observe the location of the positive post so the battery can be installed in the same way.

B. Disconnect the battery cables from the battery posts.
   1. Always disconnect the grounded battery cable first to avoid short circuits. Use care to avoid twisting the battery cable post.
   2. Pry clamp open.
   3. Pull cable off.

C. Remove the battery hold-down.

D. Remove the battery from the carrier.
   1. Use a suitable battery lift strap to lift the battery.

E. Inspect the battery carrier for dirt or corrosion.
   1. Clean with baking soda and water as required.

F. Check battery cables for worn or frayed insulation.

G. Clean the inside of battery cables clean and bright.

H. Set the battery into place using a lift strap.
   1. Position the battery to allow for correct battery cable attachment.

I. Install the battery hold-down clamp or strap and tighten securely.

J. Reconnect battery cables to the battery posts.
   1. Always reconnect the power cable first and the ground calbe last.

K. Tighten the battery cable clamps securely
   1. Use care to avoid twisting the battery cable post.

L. Spread a coating of battery anti-corrosion paste over the cable clamps and terminals.

10.3 Battery Servicing; Measure Battery Electrolyte with a Hydrometer

A. Remove vent caps from battery.

B. Insert the hydrometer into the first cell.

C. Squeeze the rubber bulb to draw electrolyte into the hydrometer to suspend the float.

1. If the electrolyte level is too low, add water until electrolyte level is correct, charge for one hour, and recheck.

D. Take reading at eye level.

1. Make sure the float is not bumping the top of the hydrometer tube or sticking to the side of the tube. Write down reading for each cell.

E. Squeeze bulb to return electrolyte to cell.

F. Repeat for other cells.

G. Adjust the readings for temperature.

1. Add four gravity points (0.004) to the reading for each $10^{o}F$ ($5.5^{o}C$) above 80^{o} (26.7^{o}).

2. Subtract four gravity points (0.004) for each $10^{o}F$ ($5.5^{o}C$) below $80^{o}F$ ($26.7^{o}C$).
3. Specific gravity should read from 1.215 to 1.270, corrected for $80^{o}F$ ($26.7^{o}C$) electrolyte temperature. The variation in readings between cells should be no more than 0.050. If the readings are not within this range, further testing will be required.

H. Replace vent caps upon completion of test.

I. Flush any spilled electrolyte with clean water.

10.4 Change Oil in an Engine

A. Support vehicle on jack stands.

B. Position drain pan under engine drain plug.

C. Remove drain plug.
1. Use care to avoid being burned by hot oil.

D. Allow the oil sufficient time to drain.
1. Observe oil condition and color that might make further service necessary.

E. Replace oil filter as required.

F. Replace drain plug.
1. Make sure the gasket, if used, is in place and the drain plug is secure.

G. Remove jack stands and lower car to floor.

H. Lift hood.

I. Remove oil filler cap.
   1. Dirt and grease should be wiped away from filler cap before removal.

J. Refill the crankcase to recommended level with the proper motor oil.
   1. Make sure the tops of the oil cans and the filling spout are clean.

K. Clean and replace oil filler cap.

L. Start engine and operate it for a few minutes at low rpm.

M. Check for oil leads.

N. Shut off engine.

O. Check oil level on dipstick.
   1. Add oil as required by manufacturer's specifications. Do not overfill.

P. Make out service sticker and apply to inner door surface.
   1. Make sure date, mileage, and type of oil are included on service sticker.

10.5 Change an Oil Filter

A. Replaceable element type oil filter on upper part of engine.

1. Clean dirt from filter cover.
2. Remove oil filter cover.
3. Remove oil filter element.
   a. use care to avoid spilling oil on vehicle.
4. Remove remaining oil from filter housing by removing drain plug from housing or use the suction gun to draw out the oil.
5. Clean filter cover and housing.
6. Remove old filter gasket.
7. Install new filter gasket into filter cover.
   a. install other small rubber gaskets as required.
8. Install new filter element.
9. Install filter cover.
   a. make sure the gasket is in place.
10. Tighten filter cover securely.
11. Add oil or refill crankcase as required.
12. Start engine.
13. Check for leads.
14. Shut off engine.
15. Check oil level on dipstick.
    a. add oil as required. Do not overfill.
16. Make out service sticker indicating date and mileage oil filter was changed.

B. Replaceable element type oil filter on lower part of engine.

1. Support front of vehicle on jack stands.
2. Position drain pan under oil filter.
3. Remove oil filter housing bolt.
4. Remove oil filter housing.
5. Remove oil filter element from filter housing.
6. Clean the filter housing.
7. Remove old oil filter housing gasket.
8. Install new oil filter housing gasket.
   a. make sure the new gasket is placed correctly.
9. Install new oil filter element in filter housing.
10. Install oil filter housing and tighten bolt securely.
11. Remove jack stands and lower car to floor.
12. Add oil or refill crankcase as required.
13. Start engine.
14. Check for leaks.
15. Shut off engine.
16. Check oil level on dipstick.
    a. add oil as required. Do not overfill.
17. Make out service sticker indicating date and mileage oil filter was changed.

C. Sealed cartridge type oil filter.

1. Support front of vehicle on jack stands if required.
2. Place drain pan under oil filter.
3. Remove oil filter cartridge with suitable tool.
   a. turn counterclockwise to remove.
4. Lubricate the sealing gasket on the new oil filter cartridge with clean motor oil if required.
5. Replace oil filter cartridge; tighten to manufacturer's recommendation.
   a. usually hand tightening is sufficient.
6. Remove jack stands and lower car to floor.
7. Add oil or refill crankcase as required.
8. Start engine.
9. Check for leaks.
10. Shut off engine.
11. Check oil level on dipstick.
    a. add oil as required. Do not overfill.
12. Make out service sticker indicating date and mileage oil filter was changed.

10.6 Remove, Inspect, Service, and Replace Spark Plugs

A. Remove spark plug wires.

1. Pull the wire from the spark plug by grasping the terminal, not by pulling on the wire.

B. Loosen the spark plugs.

C. Clean the area around the spark plug by blowing, wiping, or brushing.
   1. Loosen the spark plug approximately two turns and crank the engine so that the compression going past the spark plug threads will clean the dirt and grit from the plug seat area.
   2. Protect your eyes when using compressed air.

D. Remove the spark plugs.
   1. Arrange the spark plugs in order as they are removed. The condition of the spark plug can tell a lot about the operation of a particular cylinder

E. Remove the spark plug gaskets if required.

F. Determine the condition of the spark plugs and decide whether to replace or service them.

G. Clean the spark plugs on a spark plug cleaning machine.

H. Clean the threads with a wire hand brush.

I. Bend the ground electrode slightly to open gap.

J. File the center electrode to flatten the surface and square up the edges.

K. Reset the gaps of new and serviced spark plugs to manufacturer's specifications.
   1. Use a wire gauge to check the gap. Make sure the electrode surfaces are parallel.
   2. Bend only the ground electrode.

L. Install new spark plug gaskets as required.

M. Install spark plugs and tighten.
   1. Use caution when starting the spark plugs to avoid cross-threading.

N. Torque the spark plugs to manufacturer's recommendations.
   1. Care should be taken not to over-torque spark plugs with tapered seating surfaces because the plugs will be damaged.

O. Replace the spark plug wires in the proper order.
   1. Push the spark plug wires securely into place and make sure they are in the brackets or holders.

AUTO MECHANICS PROJECT SHEET

1. Test antifreeze solution.

The student will perform a standard antifreeze test on an auto cooling system.

REQUIREMENTS

An auto cooling system.

TOOLS

antifreeze hydrometer tester

AUTO MECHANICS PROJECT SHEET

1. Test antifreeze solution.

The student will perform a standard antifreeze test on an auto cooling system.

REQUIREMENTS

An auto cooling system.

TOOLS

antifreeze hydrometer tester

STEPS TO COMPLETION:

1. Start engine and allow time for coolant to warm to operating temperature.
2. Remove radiator cap; (not quickly when engine is hot, loosen slowly, allow pressure to escape.
3. Draw coolant into tester and empty several times to equalize temperature. Draw coolant in and leave it.
4. Read first number or letter on float above liquid surface; determine temperature of coolant.
5. Measure antifreeze content of water by comparing readings with chart on tester.
6. Determine if antifreeze will protect to 10^{0} F. less than coldest expected.
7. Add antifreeze if necessary.

2. Remove, replace battery.

The student will remove and replace an automobile battery.

REQUIREMENTS

An automobile equipped with a battery.

TOOLS AND EQUIPMENT

battery lift strap
battery post and cable cleaner
battery cable spreader
battery clamp puller
screwdriver
combination end wrenches
wire brush

STEPS TO COMPLETION:

1. Disconnect battery cables from posts; disconnect ground cable first to avoid shorts; do not twist posts. STEPS: loosen bolt, pry clamp apart with screwdriver, apply clamp puller.

2. Remove battery strap or hold-down.

3. Remove battery using lift strap.

4. Inspect areas: 1)battery carrier, clean with water and baking soda, flush; 2) battery cable clamps and post, clean with post and cable cleaner or fine sandpaper; 3) check cables for worn insulation, replace if necessary.

5. Set battery back in place with lift strap, ensuring that positive and ground posts are in proper positions.

6. Tighten battery hold-down or strap.

7. Reconnect cables, tighten; reconnect positive cable first, ground last.

8. Tighten cable clamps.

9. Smear anti-corrosion paste or vaseline over clamps and posts.

3. Measuring battery electrolyte.

The student will measure battery electrolyte, using a hydrometer.

REQUIREMENTS

An automobile battery.

TOOLS AND EQUIPMENT

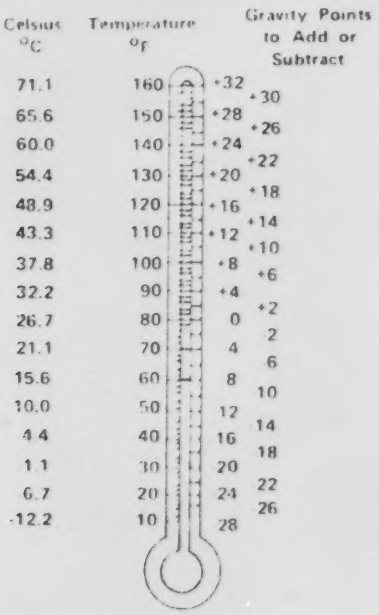
hydrometer

water

rags or cloths

STEPS TO COMPLETION:

1. Loosen and remove vent caps from top of battery.
2. Insert hydrometer into first cell; squeeze bulb to draw electrolyte into tube, draw enough to suspend the float in the tube.
3. Read at eye level, ensuring that hydrometer is vertical.
4. Write down reading.
5. Expel electrolyte fluid back into cell.
6. Repeat steps 2 through 5 for each battery cell.
7. Adjust readings for temperature; add 4 gravity points to the reading for each 10° F. above 80° F., subtract same for each 10° below. See figure.



8. Gravity should read from 1.215 to 1.270, corrected.
9. Replace vent caps, tighten.
10. Flush spilled electrolyte (it is an acid) with clean water.

4. Oil change.

The student will complete an oil change in an auto engine, using the proper tools safely, to industry standards.

REQUIREMENTS

A functioning auto engine in an automobile.

TOOLS AND OTHER EQUIPMENT

wrench to fit drain plug
drain pan
automobile jack and jackstands or other support
oil and spout
rags or cloths

STEPS TO COMPLETION:

1. Jack auto up and support on stands; engine should be warmed.
2. Place drain pan under drain plug.
3. Remove drain plug with wrench; oil may be hot, use caution.
4. Replace drain plug after oil has drained.
5. Remove drain pans, stands and lower car to floor.
6. Dispose of old oil.
7. Lift hood and remove oil filler cap, after removing dirt and grease, if any.
8. Pour recommended amount of oil (through spout).
9. Replace oil filler cap.
10. Start engine, allow to run at idle for few minutes.
11. While engine is running, check for oil leaks.
12. Turn off engine, and check oil level on dipstick; allow a moment or two after engine is turned off for oil to seep to crankcase.
13. Add more oil if required.

5. Oil filter change.

The student will change an automobile oil filter, using tools safely, to industry standard.

REQUIREMENTS

filter wrench
fender covers or drop cloths
jack
jack stands or other support
rags or cloths

STEPS TO COMPLETION:

Oil filters are generally changed at every or every other oil change.

1. Jack up automobile, support on stands.
2. Place drain pan under filter.
3. With oil filter wrench placed around cleaned filter, turn counter-clockwise until loose.
4. Remove wrench and remove filter with hands; deposit out of way.
5. Lubricate sealing gasket of new filter with clean motor oil.
6. Replace new filter; hand-tighten only.
7. Remove drain pan and auto support, lower to floor.
8. Add oil as required.
9. Start engine and check for leaks.
10. Shut off engine, allow oil to settle, check level on dipstick.
11. Add as necessary.

6. Remove, inspect, service and replace spark plugs.

The student will remove, inspect, service and replace automobile spark plugs, using tools safely, to industry standard.

REQUIREMENTS

An automobile or auto engine block with spark plugs.

TOOLS

3/8" drive spark plug socket and ratchet
appropriate extensions
spark plug cleaner
wire brush
file
feeler gauge
rags and cloths

STEPS TO COMPLETION:

1. Grab spark plug wire terminals and pull to remove.

2. Using socket, loosen spark plugs.

3. Clean area around plugs by brushing, wiping or blowing; with plugs loosened two turns, crank engine so compression will blow loose dirt from threads.

4. Remove plugs completely by turning counter-clockwise with hands; keep in order.

5. Clean plugs with spark plug cleaner after determining that they are serviceable; clean threads with brush.

6. Bend electrode back slightly to open gap.

7. File center electrode to flat, square surface and edges.

8. Re-set gap between electrodes to manufacturer's specifications by inserting feeler gauge between electrodes and tapping down slightly until gauge can be drawn through gap with minimum drag.

9. Re-install plugs; attach plug wires; ensure that original order is maintained.

APPENDIX

OCCUPATIONAL ANALYSIS

*AUTOMOBILE MECHANIC

OCCUPATIONAL ANALYSIS

State Department Code # 0800

U.S.O.E. Instructional Group Code: 17.0302UU

D.O.T. # 620 281 014

PRINCIPAL INVESTIGATORS

State Department Specialist: GEORGE WARREN

Curriculum Staff Assigned: JOHN BARTON

Task Analyst (s): HARVEY GREENLEE (MEADE & GREENLEE)

Date Analysis Completed: MARCH 1976

*NOTE: This occupation is a key occupation in Oregon as identified by Oregon Criteria.

TASK INVENTORY REVIEW COMMITTEE

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MARVIN KELSO--INTERNATIONAL ASSOC. OF MACHINISTS (PORTLAND)
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PHIL PARSONS--SPRINGFIELD BUICK (SPRINGFIELD)
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(2)

TASK INVENTORY

Auto Mechanic
Job Title

Marvin Greenlee
Analyst

INSTRUCTIONS:

List each manipulative and knowledge skill relating to the job noted above. To the right of each task is a series of columns asking specific questions about the entry level, level of difficulty, frequency and type of skill involved. Place an "X" in each of the four categories opposite the task description.

Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
1	0	Engine								
	1	Remove/replace intake manifold	X	X			X			X
	2	Remove/replace exhaust manifold	X			X			X	
	3	Remove/replace rocker arm covers	X		X					X
	4	Remove/replace cylinder heads	X	X		X	X		X	
	5	Remove/replace water pump	X	X		X	X		X	X
	6	Remove/replace timing gear cover		X		X		X		
	7	Remove/replace cam shaft		X		X		X		
	8	Remove/replace crankshaft		X		X		X		
	9	Remove/replace piston & rod assembly		X		X		X		
	10	Remove ring ridge using ridge remover tool		X			X	X		
	11	Use carbon removing tool to remove carbon from piston ring grooves		X		X		X		
	12	Use portable electric drill motor to hone cylinders		X			X	X		
	13	Remove/replace main & rod bearings		X		X		X		
	14	Use plastigage to measure bearing clearance	X	X		X		X		
	15	Use valve spring compressor tool to remove valves		X	X				X	
	16	Use valve grinder to recondition valves		X		X			X	
	17	Remove/install valve seats		X			X	X		
	18	Recondition valve seats		X		X			X	
	19	Remove/install valve guides		X		X			X	
	20	Use feeler gage to adjust valve clearance	X			X				X
	21	Use dial indicator to measure cylinder symmetry		X			X	X		
	22	Remove/replace oil pan		X		X		X		
	23	Remove/replace oil pump		X		X		X		
	24	Overhaul oil pump		X		X		X		
	25	Use hot tank method to clean block & parts		X	X			X		
	26	Use solvent to clean parts		X	X					X
	27	Use steam cleaner to clean engine		X	X			X		
	28	Pressure check block for leaks		X	X			X		
	29	Remove/replace valve tappets		X		X			X	
	30	Overhaul hydraulic valve tappets		X			X	X		
	31	Overhaul rocker arm assemblies		X		X		X		
	32	Resurface rocker arms		X		X		X		
	33	Perform cylinder compression test	X		X					X
	34	Perform visual inspection of bearings		X		X		X		
	35	Use outside mic to mic crankshaft	X				X	X		
	36	Use appropriate torque wrench to tighten bolts to specifications	X		X					X
	37	Use puller to remove vibration damper		X	X			X		

TASK INVENTORY

Auto Mechanic

Job Title

INSTRUCTIONS:

List each manipulative and knowledge skill relating to the job listed above. To the right of the page are three sections of columns asking specific questions about the Entry Level, Frequency of Performance and Instruction Attained At. An "X" should be placed, by the analyst, opposite each task in the appropriate box of the "ENTRY LEVEL" and "FREQUENCY OF PERFORMANCE" sections. Section three, "INSTRUCTION ATTAINED AT" is to be completed by state representative persons selected by the state department specialist.

Analyst

Duty No.	Task No.	Task Description	Entry Level		Frequency of Performance			Instruction Attained at			
			Entry	On The Job	Small Amount	Average Amount	Great Amount	High School	Community College	On the-Job Training	Related Training
1	38	Use electronic equipment to diagnose engine malfunction	x				x				
	39	Adjust valve timing	x			x					
	40	Remove/replace piston pins		x		x					
	41	Use overhead hoist to remove engine from car		x	x						
	42	Install engine in car		x		x					
	43	Fill engine with proper amount & type of oil	x		x						
	44	Use manufacturer's service manual to verify specifications	x				x				
	45	Use piston ring compressor to install piston		x		x					
	46	Use inside mic to measure cylinder bore & taper	x				x				
	47	Measure upper & lower con rod bore		x			x				
	48	Inspect all parts during assembly		x		x					

TASK INVENTORY

Auto Mechanic
Job Title

Marvin Greenlee
Analyst

INSTRUCTIONS:

List each manipulative and knowledge skill relating to the job noted above. To the right of each task is a series of columns asking specific questions about the entry level, level of difficulty, frequency, and type of skill involved. Place an "X" in each of the four categories opposite the task description.

Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
2	0	Electrical								
	1	Use hydrometer to test electrolyte	X		X					X
	2	Use water dispenser to fill battery	X		X					X
	3	Use cleaning tools to clean terminals	X		X					X
	4	Replace broken or worn battery cables	X	X	X				X	
	5	Remove/replace battery	X	X	X					X
	6	Use voltmeter to test battery condition	X			X				X
	7	Hook up battery to charger	X		X					X
	8	Start vehicle using booster battery	X		X					X
	9	Use load-type tester to test battery condition	X				X			X
	10	Inspect generator/alternator drive belts for wear	X		X					X
	11	Remove/replace alternator/generator		X	X				X	
	12	Use belt-tension gage to adjust drive belts	X		X					X
	13	Use volt-ammeter to measure generator/alternator output	X				X			X
	14	Overhaul generator		X			X		X	
	15	Overhaul alternator		X			X		X	
	16	Use lathe to turn down commutator & slip ring		X		X			X	
	17	Undercut mica on generator machine		X		X		X	X	
	18	Remove/install bearings		X	X				X	
	19	Use Ohmmeter to test alternator/generator wiring	X			X				X
	20	Remove/replace alternator/generator brushes		X		X			X	
	21	Perform starter amperage draw test	X			X				X
	22	Inspect starter drive & flywheel for wear		X	X			X		
	23	Adjust starter pinion end play		X		X		X		
	24	Remove/replace starter brushes		X		X		X		
	25	Test starter field coils		X		X		X		
	26	Install new starter cable	X	X	X			X		
	27	Remove/replace spark plugs	X		X					X
	28	Use gapping tool to adjust spark plug gap	X		X					X
	29	Use spark plug cleaner to clean spark plug	X		X					X
	30	Use spark plug tester to test condition of plug	X		X					X
	31	Remove/replace ballast resistor	X	X		X		X		
	32	Install proper ends on new spark plug wires	X			X				X
	33	Use application chart to select proper replacement plugs	X			X				X
	34	Use coil tester to test condition of coil	X			X			X	
	35	Remove/replace coil	X	X	X			X		
	36	Remove/replace condenser	X		X					X
	37	Test condition of condenser	X			X				X

TASK INVENTORY

Auto Mechanic
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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
2	38	Remove/replace distributor cap	X		X					X
	39	Inspect distributor cap for cracks & wear	X		X					X
	40	Remove/replace distributor		X			X		X	
	41	Use distributor test machine to test condition of distributor internal parts	X			X			X	
	42	Remove/replace ignition points	X		X					X
	43	Use dwell meter to measure point gap	X			X				X
	44	Use timing light to determine ignition timing	X			X				X
	45	Use steering wheel puller to remove ignition switch		X		X		X		
	46	Troubleshoot ignition system	X				X			X
	47	Remove/replace headlamps	X	X	X				X	
	48	Remove/replace light bulbs	X	X	X					
	49	Install new lamp sockets	X	X		X		X		
	50	Re-wire circuits with proper gage wire	X	X			X		X	
	51	Replace turn-signal flasher units	X	X		X		X		
	52	Troubleshoot lighting system problems	X	X			X			X
	53	Use headlamp aiming equipment to adjust headlights	X			X				X
	54	Install new stop light switch	X	X	X			X		
	55	Remove/replace defective fuses/circuit breakers	X			X				X
	56	Remove/replace turn signal switch		X		X	X		X	
	57	Remove/replace light switches		X		X			X	
	58	Use test light to inspect open circuits	X			X				X
	59	Install new lighting circuits		X			X	X		
	60	Install radio and speakers		X		X		X		
	61	Remove/replace courtesy light switch	X	X	X	X		X		
	62	Inspect/test brake failure warning light	X			X			X	
	63	Inspect operation of windshield wiper motors		X		X			X	
	64	Inspect operation of windshield washers		X	X				X	
	65	Clean wiper washer nozzles & adjust aim	X	X	X	X			X	
	66	Inspect operation of horn(s)	X	X	X				X	
	67	Inspect operation of antitheft buzzer	X	X	X	X		X		
	68	Inspect operation of electric windows	X	X	X		X	X		
	69	Inspect operation of electric seat	X	X	X		X	X		
	70	Inspect operation of window defroster	X	X	X	X				X
	71	Inspect operation of dash instruments & warning lights	X	X	X	X				X
	72	Remove/replace power-seat components		X			X	X		
	73	Overhaul windshield wiper motor		X			X	X		
	74	Troubleshoot heater/defroster		X			X			X

TASK INVENTORY

Auto Mechanic
Job Title

Marvin Greenlee
Analyst

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
2	75	Repair faulty horn button		X		X		X		
	76	Repair controls for automatic transmission and overdrive units		X			X		X	
	77	Test/repair antiskid braking system controls		X			X		X	
	78	Repair air conditioning controls		X			X			X
	79	Use growler to test armature	X	X		X			X	
	80	Inspect air conditioning controls for operation		X		X			X	
3	0	Fuel, Exhaust & Emissions systems								
	1	Diagnose fuel system malfunctions	X	X		X				X
	2	Diagnose emission system malfunctions	X	X			X			X
	3	Inspect heat-riser valve for operation	X		X					X
	4	Free stuck heat-riser valve	X	X		X				X
	5	Remove/replace muffler and converter	X	X		X				X
	6	Remove/replace exhaust pipes	X	X		X				X
	7	Use oxy torch to remove tail pipes	X	X	X	X				X
	8	Remove/replace exhaust manifold	X			X			X	
	9	Remove/replace fuel tank		X	X			X		
	10	Repair fuel tank		X	X	X		X		
	11	Remove/replace fuel pump		X		X		X		
	12	Remove/replace air filter	X		X					X
	13	Remove/replace carburetor	X		X					X
	14	Overhaul carburetor		X			X		X	
	15	Adjust carburetor settings	X	X		X				X
	16	Test operation of PVC valve	X		X					X
	17	Inspect/clean PCV valve	X		X					X
	18	Replace air pump		X			X	X		
	19	Test/repair air-injector assembly		X			X		X	
	20	Remove/replace fuel lines		X	X			X		
	21	Remove/replace intake manifold	X	X			X			X
	22	Clean/replace fuel filter	X		X					X
	23	Diagnose fuel gage malfunctions	X				X			X
	24	Remove/replace fuel injector		X		X		X		
	25	R/R emissions system defective parts								
	26	Service evaporative system		X		X		X		
	27	Test vacuum syste- for proper operation		X		X			X	
	28	Inspect/clean intake manifold		x		x				

TASK INVENTORY

Auto Mechanic

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
4	0	Drive Train								
	1	Troubleshoot clutch operation		X		X			X	
	2	Adjust pedal free play		X	X				X	
	3	Adjust total pedal travel		X		X			X	
	4	Remove/replace clutch disc		X		X			X	
	5	Remove/replace throw-out bearing		X		X			X	
	6	Remove/replace clutch pressure plate		X		X			X	
	7	Use aligning tool to install clutch assembly		X	X				X	
	8	Adjust manual transmission linkage		X		X		X		
	9	Remove/install manual transmission	X	X		X			X	
	10	Replace drive line U-joints		X		X				X
	11	Replace drive line midship bearings		X		X			X	
	12	Remove/replace drive line	X	X	X					X
	13	Overhaul manual transmission		X		X		X		
	14	Fill transmission to proper level with proper fluid	X		X					X
	15	Adjust bands on automatic transmission		X			X		X	
	16	Diagnose faulty operation		X		X			X	
	17	Remove/install automatic transmission	X	X		X		X		
	18	Troubleshoot transmission overdrive operation		X		X		X		
	19	Troubleshoot rear-axle assembly		X	X			X		
	20	Troubleshoot transfer case		X		X		X		
	21	Drain and fill transmission & rear-axle assembly	X	X	X				X	
	22	Remove/replace axle assembles		X	X			X		
	23	Overhaul rear-axle assembly		X		X	X	X		
	24	Overhaul transfer case		X			X		X	
	25	Remove/replace bel housing		X	X					
	26	Service universal joints		X	X					
	27	Inspect drive line alignment		X	X					
	28	Overhaul automatic transmission		X			X			

TASK INVENTORY

Auto Mechanic

Job Title

Marvin Greenlee

Analyst

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
5	0	Cooling & Heating								
	1	Remove/replace pressure/filler cap	X		X					X
	2	Use tester to pressure test cooling system	X		X					X
	3	Use gas detector to inspect for combustion leakage	X		X			X		
	4	Inspect water hoses for cracks	X		X					X
	5	Inspect drive belts for wear	X		X					X
	6	Replace v-drive belts	X			X				X
	7	Adjust v-drive belt tension	X		X					X
	8	Install new water hoses	X			X				X
	9	Perform visual inspection of cooling/heating system	X		X					X
	10	Remove radiator	X	X		X				X
	11	Install radiator	X	X		X				X
	12	Remove/ install heater radiator		X			X		X	
	13	Use gas torch to solder parts	X				X		X	
	14	Use soldering iron to solder parts	X		X				X	
	15	Test operation of heater blower motor & speed controls		X		X			X	
	16	Inspect air-cooled engine cooling system for obstruction or damage	X		X					X
	17	Remove/replace thermostat	X	X		X			X	
	18	Test thermostat for proper operation		X	X				X	
	19	Test condition of anti-freeze coolant	X		X					X
	20	Inspect water pump for leaks	X	X	X					X
	21	Remove/replace water pump	X	X			X		X	
	22	Inspect condition of fan & fan hub	X			X			X	
	23	Remove/replace core plugs		X		X		X		
	24	Inspect action of thermostatic fan hubs	X	X		X			X	
	25	Inspect automatic transmission fluid coolers for damage	X	X	X				X	
	26	Inspect oil-to-water and oil-to-air heat exchangers for damage	X	X	X			X		
	27	Install add-on auto transmission coolers		X		X			X	
	28	Perform hot-tank boil out of heater		X	X			X		
	29	Use power flush gun to flush radiator		X		X		X		
	30	Rod-out radiator		X			X			X
	31	Flo test radiator		X	X					X
	32	Chemical clean radiator on vehicle	X		X				X	

TASK INVENTORY

Auto Mechanic
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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
5	33	Inspect air conditioning system for proper mounting		X		X		X		
	34	Inspect refrigerant level	X	X		X				X
	35	Locate & replace burned fuses	X	X	X				X	
	36	Clean condenser fins	X	X		X		X		
	37	Charge air-conditioning system		X	X				X	
	38	Inspect system for leaks		X		X			X	
	39	Evacuate air-conditioning system		X		X			X	
	40	Remove/replace compressor		X		X		X		
	41	Remove/replace compressor clutch		X		X		X		
	42	Remove/replace compressor seal		X		X		X		
	43	Remove/replace coolant lines		X		X			X	
	44	Install add-on air conditioning units		X			X	X		
	45	Use service and spec. manuals when necessary	X			X				X
	46	Diagnose air conditioning controls		X			X		X	

TASK INVENTORY

Auto Mechanic
Job Title

Marvin Greenlee
Analyst

INSTRUCTIONS

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
6	0	Steering and Suspension								
	1	Inspect coil and leaf springs for wear	X	X		X			X	
	2	Inspect torsion bar for wear	X	X		X			X	
	3	Inspect shock absorbers for wear	X	X	X					X
	4	Inspect steering control arms for wear	X		X				X	
	5	Inspect for proper caster and camber adjustment		X			X		X	
	6	Adjust caster/camber		X			X	X		
	7	Remove/replace ball joints		X			X		X	
	8	Remove/replace wheel bearings		X		X			X	
	9	Install shock absorbers	X	X		X				X
	10	Remove/replace coil & leaf springs		X			X	X		
	11	Remove/replace spindles and steering knuckles		X			X	X		
	12	Inspect frame and body for damage	X	X	X	X			X	
	13	Align rear axle housing		X			X	X		
	14	Overhaul steering gear		X			X	X		
	15	Fill gear box with proper fluid	X		X					X
	16	Adjust steering gear box		X		X		X		
	17	Remove/replace power steering unit		X		X		X		
	18	Adjust power steering unit		X			X	X		
	19	Diagnose steering problems	X	X		X			X	
	20	Adjust torsion bar		X			X		X	
	21	Lube chassis to manufacturer's specifications	X		X					X

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
7	0	Wheels, Tires and Seals								
	1	Inflate tires to proper pressure	X		X					X
	2	Use tire-pressure gauge to measure pressure	X		X					X
	3	Inspect tires for wear and damage	X		X					X
	4	Use tread-depth gauge to measure tread wear	X	X	X				X	
	5	Remove/replace tubeless tires	X	X	X	X			X	
	6	Repair punctures in tubeless tires	X	X	X	X			X	
	7	Repair punctures in tubes	X	X	X				X	
	8	Remove/replace valves and extensions	X	X	X			X		
	9	Use dial indicator to measure wheel/tire runout		X		X		X		
	10	Use tire changing machine to remove tires from wheels	X	X	X				X	
	11	Inspect wheels and rims for damage	X		X					X
	12	Use wheel balancing machine to balance tires	X	X	X	X				X
	13	Use manufactures specifications to select correct replacement tires and tubes	X		X					X
	14	Inspect wheel bearings for wear		X	X				X	
	15	Inspect grease seals for wear		X	X			X		
	16	Use bearing packer to pack wheel bearings		X	X				X	
	17	Use bench press to install bearing cups		X	X			X		
	18	Use torque wrench to adjust wheel bearings	X	X	X					X
	19	Use air wrench to tighten lug nuts		X	X					X
	20	Use installing tool to install bearing seals		X	X					X
	21	Inspect wheel spindle for damage		X	X					X
	22	Inspect axle shaft for damage		X	X					X
	23	Use manufacture's specifications to adjust wheel bearings	X	X	X					X

12

TASK INVENTORY

Auto Mechanic
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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
8	0	Brakes								
	1	Use hydraulic jack or hoist to raise car	X		X					X
	2	Remove wheels	X		X					X
	3	Use wheel puller if necessary to remove brake drums		X		X			X	
	4	Use brake drum lathe to recondition drum and rotor		X		X		X		
	5	Inspect brake drum for scoring and cracks		X	X				X	
	6	Use drum gauge to inspect drum for wear		X		X				X
	7	Inspect brake lining for wear		X		X				X
	8	Use brake shoe grinder to fit shoes to drum		X			X	X		
	9	Inspect springs & self-adjusters for damage		X	X					X
	10	Inspect backing plate for distortion & wear		X	X					X
	11	Inspect wheel cylinders for leaks	X		X					X
	12	Inspect hydraulic hoses for wear & leaks	X		X					X
	13	Disassemble & inspect wheel cylinders for wear		X		X				X
	14	Use portable drill motor to hone cylinders		X		X				X
	15	Replace hoses and tubing as needed		X	X				X	
	16	Use brake spring gauge to measure usefulness of springs		X	X			X		
	17	Use brake spring pliers to install pullback spring		X		X				X
	18	Overhaul master cylinder		X			X		X	
	19	Use pressure bleeder to bleed system		X		X				X
	20	Flush hydraulic system with clean fluid		X		X				X
	21	Fill system with proper hydraulic fluid	X		X					X
	22	Overhaul disc brake system		X		X			X	
	23	Use depth-of-score gauge to inspect rotor surface for scoring	X		X			X		
	24	Use micrometer to inspect rotor thickness and runout	X		X					X
	25	Inspect brake booster for proper operation	X		X					X
	26	Remove/replace brake vacuum booster		X		X			X	
	27	Inspect brake-pedal pads for wear	X		X					X
	28	Install new brake-pedal pad		X	X			X		
	29	Adjust emergency brake cable		X		X				X
	30	Adjust brakes		X		X				X
	31	Clean and inspect wheel bearings for pitting.		X	X					X
	32	Rebuild wheel cylinders		X		X				X

13

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
8	33	Diagnose brake system faults	X	X		X				X
	34	Diagnose brake system noise	X	X		X				X
	35	Use torque wrench to adjust wheel bearing clearance	X	X	X					X
	36	Road test car for braking performance	X	X	X	X				X
	37	Reposition brake pressure differential switch		X		X				

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
9	0	Body Hardware								
	1	Remove/replace seat backs & cushions		X		X		X		
	2	Remove/replace door latch & lock assemblies		X		X		X		
	3	Align doors, deck lid & hood		X		X		X		
	4	Diagnose/repair wind noise		X			X		X	
	5	Diagnose/repair water leaks		X			X		X	
	6	Remove/replace exterior mirrors		X		X		X		
	7	Remove/replace window glass		X		X		X		
	8	Remove/repair seat & shoulder belts		X		X		X		
	9	Repair sun-roof		X			X	X		
10	0	General								
	1	Wipe up grease and oil spills	X		X					X
	2	Place safety stands under raised auto in required position	X		X					X
	3	Practice prescribed safety rules when working on electrical system	X		X					X
	4	Practice prescribed safety rules when working with welding equipment		X		X				X
	5	Wipe tools free of grease and oil	X		X					X
	6	Use fender covers to protect auto finish and upholstery	X		X					X
	7	Use parts manual to identify parts		X		X				X
	8	Fill out necessary work completion forms	X		X					X
	9	Order parts from parts supply department		X		X				X
	10	Follow employer public relations policies		X	X					X
	11	Restore threads with thread insert kit		X		X				
	12	Use flaring tool kit to make copper lines	X			X				
	13	Use thread chaser to recondition bolt threads	X		X					
	14	Use easy-out to remove broken bolts	X				X			
	15	Use tap & die set to repair bolts and holes	X			X				

15